



Journal of the International Society for Teacher Education

Volume 23 Issue 2

Approaches to Teacher Education:
Professional Development, Philosophy,
and Subject-Based Teaching



Editor: Karen Bjerg Petersen, Denmark
Associate Editor: Peggy Saunders, USA

Editorial Board

2019-2020 Members: Anne Selvig Ask, Norway; Cornelia Brodahl, Norway; David Byrd, USA; Ingebjørg Aarek, Norway; Karen Bjerg Petersen, Denmark; Kemma Tsujino, Japan; Leanne Taylor, Canada; Michael van Wyk, South Africa; Modupe Osokoya, Nigeria; Nuray Senemoglu, Turkey; Peggy Saunders, USA; Sheryl Rushton, USA; Vera Lucia Fellicetti, Brazil; Vera Woloshyn, Canada.

ISfTE Officers and Elected Members

Secretary General, Susan Tilley, Canada; Treasurer, Sheryl Rushton, USA; JISTE Editor, Karen Bjerg Petersen, Denmark; Kezang Tshering, Chair, Le’Ora Cordist Trust, Bhutan; Jackie Chan, Hong Kong, at large member; Nuray Senemogly, Turkey, at large member; Modupe Osokoya, Nigeria, at large member; Ailwei Solomon Mawela, South Africa, at-large member; Katie Weir, Australia, at-large member; Vera Woloshyn, Canada, at large member.

Ex-Officio Members

Jacky Pow, former SG; Seminar conveners 2019, Leanne Taylor & Vera Woloshyn, Canada; Seminar conveners 2020, Kezang Sherab & Ugyen Choden (Bhutan)

Reviewers, Statistical Consultants, Final Review, and Editing

We are indebted to the following individuals who gave their time and expertise to review the manuscripts for this issue. We could not do this job without their reviews.

Ingebjørg Aarek, Agder University, Norway; Joshua Oluwatoyin Adeleke, University of Ibadan, Nigeria; Anne Ask, Agder University, Norway; Cornelia Brodahl, University of Agder, Norway; David Byrd, Weber State University, USA; Vera Lucia Fellicetti, Centro Universitário La Salle, Brasil; Anna Niitembu Hako, University of Namibia, Namibia; Louise Moulding, Weber State University, USA; Modupe Osokoya, University of Ibadan, Nigeria; Karen Bjerg Petersen, Aarhus University, Denmark; Lucila T. Rudge, University of Auckland, New Zealand; Sheryl Rushton, Weber State University, USA; Peggy Saunders, Weber State University, USA; Nuray Senemogly, Hacettepe University, Turkey; Prisca Tautiko Shikongo University of Namibia, Namibia; Leanne Taylor, Brock University, Canada; Kemma Tsujino, Osaka City University, Japan. English edit and final reviews: Peggy Saunders, Weber State University, USA.

JISTE is an official, refereed publication of ISfTE. The goal of ISfTE is to publish five to eight articles in each issue. Using the seminar theme, articles in the first issue of each volume are based on papers presented at the previous seminar. Articles in the second issue are non-thematic or have special themes. Points of view and opinions are those of the individual authors and are not necessarily those of ISfTE. Published manuscripts are the property of JISTE. Permission to reproduce must be requested from the editor.

JISTE is issued twice yearly by the International Society for Teacher Education. The subscription price of \$75.00US is included in the annual membership fee. Institutional subscription to JISTE is \$95.00US per year.

Table of Contents

From the Editors:
Karen Bjerg Petersen and Peggy J. Saunders4

From the Associate Editor:
Peggy J. Saunders5

Articles

Participant-Centered Adjunct Faculty Development: A Case Study
 Using the Great Teachers Model
Colleen Packer6

The Usefulness of Technology in Teacher Professional Development:
 Extending the Frameworks
Dragana Martinovic, Yifat Ben-David Kolikant, & Marina Milner-Bolotin.....21

Enacting the Educational World in Compassion: A Reflection and Positioning
 of How to Teach and Learn the Art of Compassion
Augustine Parattukudi37

Teacher Education in a Post Nation State Era: A Possible Ecological Approach:
 A Discussion and Reflection
Karen Bjerg Petersen & DeeDee Mower53

Impact of Adizes’s Team Roles on Collaboration, Disagreements, and Success in
 Student Enterprises – Teamwork Pedagogy in Higher Education
Ida Ulrikke Valand & Tormod Bjørkkjær68

Conceptual Understanding and Application of Diffusion and Osmosis:
 An Assessment of Pre-Degree Students in a Nigerian University
Adenike Julianah Oladipo, Modupe Osokoya, & Uchenna Udeani82

Experimental Studies of the Affordances of Assistive Multimodal Learning Designs:
 Universal Design for Learning in Modern Language Classrooms
Henrik Kasch93

Journal Information

Publication Guidelines108

Future Issues and Submission Deadlines109

Front Cover Information110

From the Editors – About this Issue

Karen Bjerg Petersen and Peggy Saunders
Editors of JISTE

We are pleased to present this open issue of the *Journal of the International Society for Teacher Education* featuring the theme: Approaches to teacher education: professional development, philosophy, and subject-based teaching. Some articles in this issue were originally presented in paper groups at the annual Seminar of the International Society for Teacher Education (ISfTE), which was held in Japan, in May 2018. Other articles were initially presented at the annual ISfTE Seminar, held in Canada, in May 2019. Finally, some of the articles in this open issue are submitted to our journal from scholars outside the ISfTE society. The authors in the issue address a variety of aspects in teacher education worldwide – from philosophical reflections to specific subject teaching strategies and research, and professional development of teachers.

Two articles in this issue address professional development of either higher education faculty or K-12 teachers. Colleen Packer from USA in her article, *Participant-Centered Adjunct Faculty Development: A Case Study Using the Great Teachers Model*, suggested a participant-based faculty development model to be used with adjunct faculty development because a participant-based approach has been shown to be more relevant and preferred by the faculty. Dragana Martinovic, Yifat Ben-David Kolikant, and Marina Milner-Bolotin Canada/Israel in their article, *The Usefulness of Technology in Teacher Professional Development: Extending the Frameworks*, proposed three models to demonstrate how technology could become a vehicle for providing timely and content-related support for teachers.

Philosophical approaches, discussions, and reflections are reflected in two articles from respectively Canada and Denmark/USA. Being influenced by Asian Buddhist philosophy, Augustine Parattukudi in the article, *Enacting the Educational World in Compassion: A Reflection and Positioning of How to Teach and Learn the Art of Compassion*, proposed a new model of teaching and learning of compassion, based on embedded storytelling and non-egocentric responsiveness from the side of teachers and teacher educators. In their article, *Teacher Education in a Post Nation State Era: A Possible Ecological Approach. A Discussion and Reflection*, Karen Petersen and DeeDee Mower from Denmark and USA respectively, suggested ecological approaches to be included in teacher education and teaching. An ecological approach in education and teacher education focuses on uniqueness, integrity, resilience, and personal development of students in combination with a skills focused training of the student as a whole person.

Three articles in this issue are dedicated to subject teaching. Ida Ulrikke Valand and Tormod Bjørkkjær from Norway highlighted collaboration as one of the most important 21st century skills in student enterprises focused on food and nutrition and teacher education in home economics courses in their article, *Impact of Adizes' Team Roles on Collaboration, Disagreements and Success in Student Enterprises – Teamwork Pedagogy in Higher Education*. In the article *Conceptual Understanding and Application of Diffusion and Osmosis: An Assessment of Pre-Degree Students in a Nigerian University*, Adenike Julianah Oladipo, Modupe Osokoya, and Uchenna Udeani from Nigeria introduced the complexity and difficulties of biology students to being able to develop a conceptual understanding and to apply the biological and chemical

processes diffusion and osmosis outside the classroom. Finally, in the article *Experimental Studies of the Affordances of Assistive Multimodal Learning Designs: Universal Design for Learning in Modern Language Classrooms*, Henrik Kasch from Denmark, introduced how three ebook prototypes based on the universal design for learning concept helped English/foreign language students in grade seven improve their lexical competence and self-regulated learning through digital scaffolds.

The titles and content of the articles in JISTE 23.2 evidence how many various aspects of teacher education, researchers, and teacher educators are addressed throughout the world. The articles witness the continuous engagement, which represent the dedicated educators throughout the world and demonstrate a deep interest in the many aspects and angles of teacher education, teaching, and learning.

Additionally, we would like to thank the reviewers, who have contributed with several and repeated reviews on the submitted articles for this issue. We are grateful for the active support from scholars from all over the world, members and non-members of ISfTE, who have spent their time and used their expertise to review the manuscripts.

From the Associate Editor

Peggy J. Saunders

This edition of JISTE is my last. Over the years I have edited approximately 16 editions of the journal. Editing an international journal is not an easy task; it is time-consuming and exhausting. I have enjoyed the challenge of each article and celebrated when each edition is complete. I thank all the authors who have taken my editing favorably realizing that my ultimate goal was not to tear down their writing but to help them have the best published article possible.

I would like to thank Karen Bjerg Petersen for her dedicated work on this journal. She has guided it with professionalism and hard work over these past 10 years! I would also like to thank my colleagues at Weber State University, David Byrd and DeeDee Mower, who have agreed to take over the final editing task. I am thrilled to leave the journal in such good hands.

And finally, to all the members of ISfTE, I have been honored to know you and call you my colleagues and friends. You are an amazing group of dedicated professionals who realize that education is global and that we are all in this together.

PARTICIPANT-CENTERED ADJUNCT FACULTY DEVELOPMENT:
A CASE STUDY USING THE GREAT TEACHERS MODEL

Colleen Packer
Weber State University, USA

Abstract: *Adjunct instructors represent upwards of 70% of college and university faculty in the United States, yet they often lack the resources and training to assist them in promoting student success. This study describes the implementation and perceived impact of a participant-based faculty development model adapted for use with adjunct faculty. The model focused specifically on teaching innovations and challenges. This study examined an institutional-level faculty development initiative based on the use of the Great Teachers Movement paradigm. This participant-based model provided opportunities for teachers engage in highly interactive discussions where they shared teaching innovations and sought solutions to teaching problems and challenges. Quantitative and qualitative data from 31 adjunct faculty participants provided the sources for data analysis. Results showed that adjunct instructors preferred the participant-based model over traditional presenter-based models of faculty development.*

Keywords: adjunct professors, Great Teachers Movement/Model, professional development, participant-based

Note: For this study, adjunct faculty are defined as those faculty members who have “a temporary affiliation with an institution in performing a duty or service in an auxiliary capacity” (National Center for Educational Statistics, p. D-3). Part time, contingent, and auxiliary faculty are other terms that have been used to describe these instructors. Adjunct faculty members teach part-time and are not on a tenure-track appointment at the institution. The adjunct instructors in this study have other full-time jobs either at the institution or at other organizations not directly affiliated with the campus. Some were also retired from other organizations. (For a more detailed typology of adjunct instructors in general, see Gappa & Leslie, 1993).

Introduction

Over the last several decades, the use of adjunct faculty has grown to the point where

adjuncts play a major role in the success colleges in the United States (US). Rising instructional costs and increased student enrollments have led to a steady increase in the numbers of courses taught by adjunct faculty members in colleges and universities throughout the US (Leslie & Gappa, 2002; Lyons & Burstad, 2007). With this increase in adjunct faculty comes the challenge of meeting and supporting their professional development needs.

This case study examined the use of a participant-based faculty development model to train adjunct instructors in pedagogical strategies while providing opportunities for them to network and connect with other colleagues. It is hoped that this case study will provide details about and insights into a faculty development model that can be used to enhance the training of adjunct instructors.

Literature Review

Adjunct faculty are becoming more integral in helping universities pursue their institutional missions (Leslie & Gappa, 2002; Lyons & Burstad, 2007) representing upwards of 70% of post-secondary faculty in the United States (U.S. Department of Education, 2013). Stakeholders in higher education such as state legislatures, business leaders, and others have challenged institutions to serve a growing student population. Institutions have met this challenge through increased use of adjunct instructors who provide a flexible and affordable way for institutions to achieve their instructional goals. Additionally, adjunct faculty are crucial in meeting course demands.

Wallin (2010) suggested that colleges could not survive without adjunct instructors due to the economical, professional, and instructional benefits they provide to the institution. Financial estimates show that adjunct faculty cost a university approximately 33%–40% of a full-time faculty member's salary to teach the same classes, primarily because of the cost of employee benefits are not afforded to adjunct instructors (Forbes, Hickey, & White, 2010; Schneider, 2004). As a result of this financial benefit, many institutions are able to meet course demand using adjunct faculty to teach classes that would otherwise cost too much to be consistently offered to students. Adjunct faculty also benefit higher education institutions professionally. Often, adjunct faculty have career positions and experience in industry beyond the academic setting. They bring a plethora of professional experiences from business and industry to the classroom that students are seldom exposed to with full-time faculty members (Wallin, 2010). This professional expertise and workplace experience can be invaluable to

students as they prepare to enter career areas similar to their adjunct instructors. Thus, adjunct faculty serve as a professional “link between the community and the college” (Wallin, 2010, p. 377). Finally, adjunct faculty offer instructional benefits to students and the institution. Many adjunct faculty express their excitement for teaching because of the opportunity to share their professional competencies and interact with students. Their professional experience often adds a unique dimension to the instruction they provide. Phillippe (2000) argued that adjunct faculty are often hired for technical expertise they can impart to students through instruction.

In sum, adjuncts can be a valuable economical, professional, and instructional resource for higher education institutions. Yet, if institutions want to increase the likelihood of realizing these benefits, it is imperative to provide professional development opportunities and institutional support to meet the needs and increase retention of this particular group of faculty. As Diegl (2013) argued, “adjunct faculty have a significant presence in higher education institutions and need opportunities available to them, so they feel like an important part of academic culture and prepared to teach” (p. 596).

Adjunct faculty have many of the same professional development needs as full-time faculty, yet they rarely receive the opportunities available to tenured and tenure-track colleagues. Wallin (2010) called for a “concerted effort to offer professional development and growth opportunities” (p. 390) in order to demonstrate the institution's commitment to its adjunct faculty. Professional development represents an investment in the capabilities of adjunct instructors. Providing professional development opportunities to adjunct faculty

is an indication of their import to institutions of higher education, especially in undergraduate settings (Roueche, Roueche, & Milliron, 1995). Additionally, Jaschik (2010) suggested that support for adjunct faculty development is likely to promote student success in terms of retention, which is a primary concern in today's institutions of higher education.

Orientations to university practices are designed to assist adjunct faculty in learning institutional and departmental policies and procedures (Kelly, 1990; Lyons & Kysilka, 2000). Recent studies have explored the use of digitally-based faculty development resources including video, modules, digital courseware, discussion boards, and video-conferencing as means to provide an orientation to the institution. Additionally, digital resources make possible the training and involvement of adjunct faculty at off-campus and satellite sites (Maldonado & Riman, 2009). Instructional designers and content experts develop the content and methods of delivery for these digital programs. Although the digital content may be convenient in terms of access, the digital resources focus mostly on institutional information and content delivery, not teaching and learning.

Many adjunct faculty lack pedagogical knowledge, especially in new techniques such as evidence-based learning (Major, Harris, & Zakrajsek, 2016), high-impact practices (Kuh, 2008), teaching with technology (Bates & Poole, 2003), flipped classrooms (Gilboy, Heinerichs, & Pazzaglia, 2015), and so forth. As such, the fundamental processes of teaching and classroom management strategies should be an integral part of adjunct faculty development. Wallin (2010) suggested that any training session for adjunct faculty should demonstrate the use of teaching techniques that they can adapt and

integrate into their own courses. Programs that address teaching-related content within their adjunct faculty development efforts suggested instruction in syllabus writing, lecturing, leading discussions, designing individualized learning experiences, designing and evaluating tests, and teaching adult learners (Forbes et al, 2010; Kelly, 1990). Lyons and Kysilka (2000) described a teaching methods course (taught in four sessions for four hours on Saturday mornings) mandated for all new adjunct faculty. In addition to the information presented above, the course also included instruction in planning resources, professionalism, managing class time effectively, and various teaching techniques. A growing body of literature addresses online professional development for online adjunct instructors (see Shattuck, Dubins, & Zilberman, 2019) with the assumption that adjunct faculty who teach online should experience and learn about online teaching and learning in an online format.

A third area of focus for adjunct faculty development is creating a sense of connection to the institution and assimilating adjuncts into the broader academic community (Bethke & Nelson, 1994; Gappa & Leslie, 1993). The primary means of accomplishing this objective is to facilitate interaction between adjunct faculty and other members of the university community (Dolan, 2011; Fagan-Wilen, Springer, Ambrosino, & White, 2006). To illustrate, Fagan-Wilen et al. (2006) suggested that at least one staff member of a teaching and learning center be present at every professional development event involving adjuncts in order to cultivate, maintain, and support relationships with them. Making connections with colleagues and the institution is often accomplished through peer support and dialogue (Kemery & Serembus, 2019). These connections are

often facilitated through one-on-one, personalized programs of adjunct faculty development through peer-mentoring (Kelly, 1990; Kemery & Serembus, 2019; Luna, 1990; Lyons & Kysilka, 2000), team-teaching with full-time faculty members (Leitzel, 1990), and one-on-one coaching with more established faculty members, whether they be full time or adjunct faculty (Palacio, Vargas, & Taborda, 2019).

Ongoing professional development for adjunct faculty is difficult given the multiple barriers they face such as distance, variable teaching schedules, working outside the institution, and so forth (Brannagan & Oriol, 2014; Fura & Symanski, 2014). Yet, many institutions offer ongoing professional development opportunities including *brown bag* workshops, teaching newsletters, online teaching tips, faculty learning communities, and resource centers (Kemery & Serembus, 2019) to name a few. With the possible exception of faculty learning communities, the reviewed literature suggested that these initiatives were created and presented by teaching and learning center professional staff and/or academic department chairs and faculty.

Finally, adjunct faculty also have professional development needs for recognition. Recognition can come in many forms: Receiving verbal or written praise from supervisors, department chairs and/or students; being recognized for years of service at the institution; compensation for professional development efforts; public recognition through institutional media outlets, both print and digital; and the ability to participate in professional development offerings (Dolan, 2011). Lack of recognition can negatively impact adjunct motivation and institutional loyalty. Student retention can also suffer. Research indicates that meaningful recognition and “strong

incentives for instructors” improves adjunct faculty motivation and helps “build and maintain a positive experience...for students” (Dolan, 2011, p. 65).

Adjunct faculty development efforts vary across institutions. Many institutions offered face-to-face sessions, while others offered alternative delivery approaches through online faculty development programs (Maldono & Riman, 2009; Pete, 2016). Some efforts focused on teaching in traditional classrooms and others focused solely on adjunct faculty who taught fully online courses (Kemery & Serembus, 2019; Shattuck et al., 2011). Yet, most of these programs had one common characteristic: A top-down approach in presentation.

For purposes of this study, top-down or presentation-based approaches to educational development are those where participants listen to or watch a presentation with little to no interaction among colleagues. Session content is determined by those presenting to the participants. In contrast, a participant-centered approach focuses on facilitating participant interaction about salient topics. The difference might be compared to the proverbial sage on the stage (presentation-centered) and the guide on the side (participant-centered). Participant-centered models of faculty development are closely akin to high impact practices (Kuh, 2008) in that they foster meaningful interactions, encourage collaboration, and value participant voice and experience.

Few studies described specific participant-centered faculty development initiatives. More specifically, research has not explored initiatives that value the voice of adjunct faculty members, which is often overlooked in higher education (Frederickson, 2015). After researching the needs of adjunct faculty, Dolan (2011) called for professional

development events that privileged peer-to-peer interaction. Regarding adjunct faculty, she stated that “learning from their peers’ knowledge and experiences would provide inspiration that could make them better teachers” and assist them in developing “their skills in a more effective, efficient and inspiring manner” (pp. 72-73). This research is a response to the call for implementing faculty development initiatives that utilize peer-to-peer interaction, in short, a participant-centered approach.

The *Great Teachers Model*, created by Gottshall (1993), privileges participant-centered practices. The National Great Teachers Movement began in 1969 in the US as a result of faculty being experts in their respective disciplines, yet not having extensive training in the art of teaching. Gottshall held that well-facilitated shoptalk was one of the highest forms of professional development. Thus, the Great Teachers Model boasts highly interactive discussions focused on narratives of teaching success, pedagogical practices, and instructional challenges.

Thus, the Great Teachers Model provided the foundation for a new initiative for adjunct faculty development at a large, public university in the western US. Previous adjunct faculty development efforts featured traditional presenter-centered sessions led by an expert presenter who would present a session on what was determined to be a relevant, useful topic for adjunct faculty members. Feedback from these traditional sessions suggested other topic areas, questioned the concepts that were covered, and revealed a desire for more interaction with others in attendance. The initiative described in this study was a response to those criticisms. In essence, the adjunct faculty were ready for a change and for their voices to be heard.

Purpose

Faculty developers at this western university implemented a new initiative for an adjunct faculty retreat based on the Great Teachers Model with the ultimate goal of training and retaining a cadre of qualified adjunct faculty. The seminar format provided opportunities for faculty to collaborate and connect through highly interactive discussions where participants shared teaching innovations and sought solutions to their problems and challenges in university teaching. As such, this model was adapted for use in an adjunct faculty professional development retreat.

The content of the retreat was determined by the participants themselves. Prior to coming to the retreat, participants prepared a handout that informed the focus of the day’s sessions. The handout included information that would be discussed in small groups including a teaching success story, a favorite pedagogical practice, an unresolved teaching problem, an object lesson, device or activity, and a book, article, or quote that had helped the participant in their work as an instructor. This information was shared during the retreat in highly interactive discussions in small group settings with facilitators who provided structure and guidelines to assure effective use of time. This exposure to and experience with instructional strategies was designed to build pedagogical confidence and competence within participants.

The retreat was also designed to integrate ice-breaker activities where participants would introduce each other, followed by participant interaction in new groups during each session. Additionally, meals provided opportunities for participants to interact with each other on a more informal basis, with an overarching outcome of creating stronger connections among the adjunct teaching community.

In summary, the retreat was designed to meet the goals of providing training in instructional strategies and developing connections with other adjuncts, full-time faculty and staff through the use of a participant-based instructional model. Thus, the purpose of the retreat was two-fold: First, to provide access to practical, evidence-based teaching strategies that participants could immediately integrate into their teaching, and second, to provide opportunities for participants to connect with other members of the campus community. At the completion of the event, it was hoped that participants would be able to (a) identify at least two strategies for effective undergraduate education that could be integrated into their own teaching, and (b) connect with at least one other participant with whom they could share teaching ideas and concerns related to being an adjunct instructor. Thus, this study proposed the following hypotheses:

H1: Participant-centered models of faculty development provide adjunct faculty with instructional strategies that can be easily used in a classroom.

H2: Participant-centered models of faculty development create connections among participants.

H3: Adjunct faculty perceive participant-centered models of faculty development as more favorable than traditional, presenter-centered models of faculty development.

Method

One goal of a case study is to lay a foundation for understanding broader trends and issues that can be applied to similar circumstances (Yin, 2018). This research utilized a case study approach to explore the impact of a participant-centered model for adjunct

faculty development, namely the Great Teacher's Model. The study focused on a typical event that many institutions could use as means of adjunct faculty development. The shift in focus from a presenter-centered model to a participant-centered model illuminates a new way of thinking about adjunct faculty development - one that privileges adjunct faculty voice throughout the event.

The university's teaching and learning center hosted the annual adjunct faculty retreat focused on the sharing and development of instructional strategies. Being sensitive to adjunct faculty schedules, the retreat was held on a satellite campus on a Saturday to allow adjunct faculty the opportunity to attend without having to take time away from their full-time employment. Each adjunct faculty member participated in the day-long training session.

Participants

Participants in this study included 31 adjunct instructors at a 4-year, large, public university in the western United States. Teaching experience ranged from one semester to 22 years. The highest number of participants were from the College of Arts and Humanities (14); with 4 each from the College of Science and the School of Business; 3 each from the Social Science and Engineering Colleges; 2 from the College of Education; and 1 from the College of Health Professions. Of the 31 participants, 22 had attended previous adjunct faculty retreats that had used presenter-centered formats with formal presentations, sessions, and workshops.

Data Collection and Analysis

Quantitative and qualitative data from 31 adjunct faculty participants were aggregated for the purpose of analyzing faculty perceptions of the model overall including its impact on increasing awareness of instructional strategies and facilitating a sense of community with other campus entities. At the completion of the retreat, participants completed a feedback survey that measured adjunct faculty attitudes across three areas: (a) instructional strategies; (b) creating connections; and (c) retreat format. Survey questions were developed for each construct in a collaboration between the Director of the institution's teaching and learning center and the Director of Academic Analytics. Eleven questions focused on pedagogy; five questions focused on connections; and six questions focused on the overall format (see Appendix A). The quantitative data were analyzed using simple descriptive statistics. Three open-ended questions focused on retreat strengths, areas for improvement, and additional adjunct support needs. Qualitative data were analyzed using a deductive thematic analysis, analyzing patterns across the data set (Huberman & Miles, 2000). Thematic analysis was chosen because it is not associated with a specific epistemological

perspective, which makes it a flexible method of analysis, especially in the context of teaching and learning research (Clarke & Braun, 2013; Maguire & Delahunt, 2017).

Results

Results supported all three hypotheses with positive feedback in each construct. Most participants (88.79%) learned new instructional strategies that they could use in the classroom. Participants either agreed or strongly agreed that they learned new skills to improve their teaching, which was one of the major purposes of the retreat. In terms of making connections, 87.1% of participants indicated that the retreat offered them opportunities to make connections with either other adjunct faculty, full-time faculty, and/or the institution as a whole. All but one participant felt like they were part of a teaching community as a result of participating in the retreat. The participant-based format of adjuncts interacting with each other and facilitators was preferred over the presentation-centered format of keynote speakers with breakout sessions by 81.7% of those participants who had attended presenter-centered retreats in the past. Figure 1 shows the frequency distribution of responses across constructs.

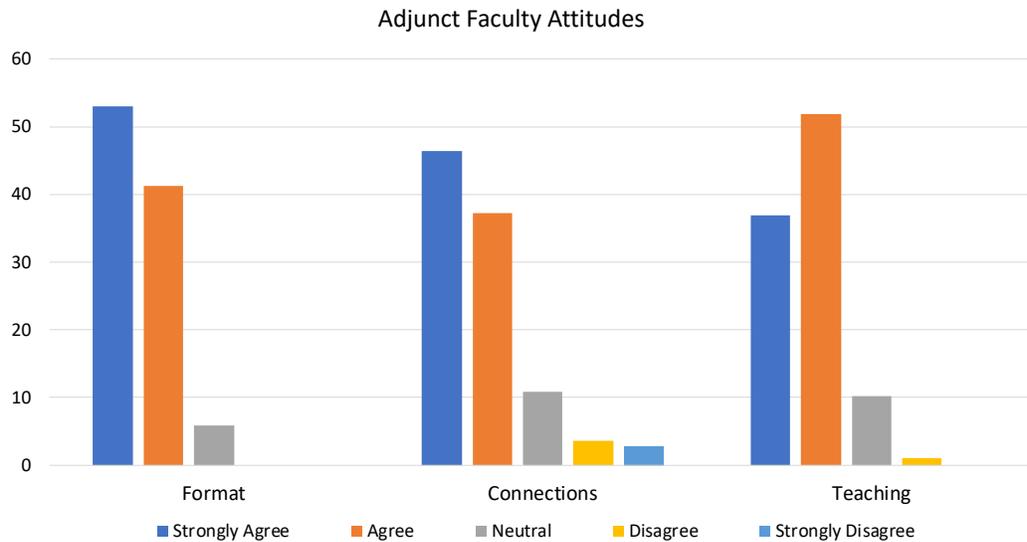


Figure 1. Frequency distribution of responses across constructs

Participants also provided feedback regarding their best experiences at the event. The two specific areas of strength that emerged from the data were in line with the two foci of the retreat: learning new teaching strategies and connecting with other faculty members. One participant said that “[I] enjoyed listening to different pedagogical activities that can be implemented into a teaching moment.” Faculty enjoyed engaging in “shop talk” with others because of the variety of perspectives they were able to experience. The homework handouts were appreciated as well. One participant indicated that the “assignment in advance (referring to the handout) helped prepare for the retreat better than in previous years.” Another shared similar sentiments: “I liked the handouts” because “I could refer to them when I needed to.”

The second emergent theme from the data focused on connecting with the campus learning community. The opportunity to interact and network with other adjuncts and full-time faculty was mentioned throughout the data. Participants appreciated the

interaction because their teaching and classroom concerns were addressed by others, and they realized that there were other “teachers who are in the same boat as me (sic).” The format also minimized socially constructed professional barriers to the point that “formal titles and individual experiences took a back seat to collaboration and discussion.”

A thematic content analysis of qualitative data focused on improving the event revealed two major themes: (a) more disciplinary discussions and (b) more involvement from full-time faculty. Participants felt that they benefitted from discussing specific teaching ideas with faculty from the same or similar disciplines. Said one participant, “I liked being able to learn from different groups of people, but I think the object lesson would be better shared with similar disciplines.” Another shared a similar view: “Maybe have one section where teachers from similar disciplines can interact. The final application discussion with similar disciplines.” Other participants shared their desire for more full-time faculty participation. One particular

quote captured that idea, *“It might really be helpful to have a few more full-time faculty participate. More regular faculty would be useful.”* These findings provide a useful point of departure from which to explore improvements in using the model for future adjunct faculty development efforts.

Discussion

This study explored adjunct faculty perceptions of a participant-centered model of professional development and its impact on their pedagogy and ability to connect with others in the university community. Findings indicated that adjunct faculty preferred the participant-centered model over the traditional presenter-centered format so commonly used for professional development events. Preference for the participant-centered format validates research calling for face-to-face, peer-driven interaction (Dolan, 2011) in adjunct faculty development efforts. The opportunity to interact with peers brings multiple benefits to the professional development experience and allows participants to develop their skills through learning from each other. Although research identifies five components of a comprehensive program for adjunct faculty development, this study focused on the two components that emerged specifically from the data, namely teaching and connection.

A primary benefit of this participant-based model is that adjunct faculty learned teaching techniques that could be easily adapted for immediate use in their own classrooms. Yet, there is no guarantee that adjunct faculty will become familiar with new techniques such as evidence-based learning (Major et al., 2016) or high impact practices (Kuh, 2008) unless participants choose to share these types of teaching techniques with their peers. Because participants share their own tried-and-true teaching ideas and experiences, the lack of

exposure to new teaching strategies may prove to be a potential drawback to a participant-based model. As such, anyone using this model should provide a general definition and/or explanation of new, innovative teaching strategies and encourage participants to share strategies that fall within that purview. Doing so will increase the likelihood that participants will become exposed to and familiar with current teaching strategies that can be integrated into their own classrooms.

Another primary benefit of using a participant-based model was the sense of connection created among participants. This entire model was predicated upon peer-to-peer interactions where participants shared their teaching ideas and challenges with each other. Because the adjunct faculty voices were an integral component of this professional development experience, participants were able to network and make connections with other adjunct and full-time faculty while learning new instructional strategies that they could use immediately in their classrooms. Based on existing research (Dolan, 2011; Fagan-Wilen et al., 2006), it stands to reason that adjunct faculty would identify networking and making connections with their peers a valuable part of the experience as interaction is the means by which creating a sense of community occurs. An advantage to the participant-based model described in this case study is that multiple connections can be facilitated at once, perhaps an improvement over (or a precursor to) individualized peer-to-peer programs described earlier (see Kemery & Serembus, 2019). These connections can occur within and across disciplines because participants engage with new groups for different purposes throughout the event.

Participants also indicated that they would like more full-time faculty involvement,

although they did not indicate why. Yet, one can assume, that if adjuncts had a desire to assimilate into the broader academic community, then it stands to reason that interaction with more full-time faculty would be viewed as advantageous. Networking with other adjuncts was found useful, but adjuncts may view full-time faculty as being more knowledgeable about campus culture, pedagogical strategies, and thus, more likely to assist them in becoming part of an academic community.

Thematic content analysis of qualitative data revealed that participants had positive perceptions about exposure to new teaching strategies and feeling as if they were part of an academic team. On the surface, these findings suggest validation and support for using the Great Teachers Model. Yet, priming (see Meyer & Schvaneveldt, 1974) may have been a factor in participant comments within the qualitative portion of the retreat evaluation and survey because the quantitative questions focused on teaching strategies and making connections. Priming suggests that exposure to one stimulus will influence the response to another stimulus (Bargh & Chartrand, 2000). Participants had responded to multiple questions regarding both areas in the quantitative portion of the evaluation survey. Thus, they may have been primed to focus on those areas during the qualitative portion of the study. Future studies should be sensitive to priming effects to determine if participants address these categories on their own without previous exposure to the topics. If participants identified these areas without the influence of priming, findings may reflect stronger agreement among participants.

As with any study, this one is not without its limitations. A significant limitation is the reliance of self-report data immediately following the event. Because findings are

based on faculty self-reports, the reported outcomes of learning new pedagogical strategies may not be occurring in actual classroom practice. Observing classroom practice is a logical follow-up and next step in this research. Exploring the impact of the event on classroom teaching behaviors would provide stronger evidence to either support or rethink the retreat framework. This assessment could be accomplished through direct observation of classroom teaching by teaching and learning center staff, video self-monitoring, and/or teacher reflection by the adjunct faculty themselves. In the future, rubrics may provide a more standardized, valid manner of receiving feedback on innovative teaching strategies.

This case study focused on a specific approach to adjunct faculty development. Additional research could employ the use of focus groups to discuss participant experiences and perceptions, how to improve exposure to new teaching strategies, and institutional connections. Future research could also explore similarities and differences based on faculty demographics (such as new faculty compared to seasoned faculty, gender differences, disciplinary differences, and so forth). These differences may inform and perhaps lead to revisions in how the model might be better adapted to different adjunct faculty groups. Finally, although this is a case study focusing on a specific approach to faculty development for adjunct instructors, more data could be gathered to get a better sense of how the intricacies of the model could be strengthened to promote and facilitate professional development training in multiple contexts, perhaps beyond academia.

Conclusion

As institutions of higher education world-wide continue to weave adjunct faculty into

the fabric of their organizations, the importance of their professional development cannot be overstated. Many courses taught by adjunct faculty are general education and/or introductory courses that include numerous first- and second-year students whose success and retention rely on effective pedagogical practices. In a climate focused on student success, it is imperative that the adjunct faculty who interact with these students understand the teaching and learning process, good teaching practices, and methods to increase student engagement in the classroom. Professional development, in any form, should provide opportunities for and create greater mindfulness of the teaching and learning process, which “helps to create more intentional teaching processes” (Saginaw Valley State University,

2014, p. 1). A participant-centered model based on the Great Teachers approach is one faculty development initiative that provides these experiences in a way that facilitates university teaching success for adjunct faculty.

Adjunct faculty are here to stay, and as such, should be recognized and valued as professional colleagues and integrated into the college community. When adjunct faculty develop stronger instructional competencies and a sense of belonging to a teaching community, they become a capable force in achieving and maintaining the teaching missions and reputations of institutions of higher education world-wide.

References

- Bates, A. W., & Poole, G. (2003). *Effective teaching with technology in higher education: Foundations for success*. San Francisco: Jossey-Bass.
- Bethke, R., & Nelson, V. (1994, May). *Collaborative efforts to improve conditions for adjunct faculty*. Paper presented at the 16th Annual International Conference of the National Institute for Staff and Organizational Development on Teaching Excellence and Conference of Administrators, Austin, TX. Retrieved from <https://files.eric.ed.gov/fulltext/ED373822.pdf>
- Bargh, J. A., & Chartrand, T.L. (2000). Studying the mind in the middle: A practical guide to priming and automaticity research. In Reis, H. & Judd, C. (Eds). *Handbook of Research Methods in Social Psychology* (pp. 1–39). New York: Cambridge University Press.
- Brannigan, K. B., & Oriol, M. (2014). A model for orientation and mentoring of online adjunct faculty in nursing. *Nursing Education Perspectives*, 34(6), 128–130.
- Clarke, V., & Braun, V. (2013). Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The Psychologist*, 26(2), 12–123.
- Diegel, B. L. (2013). Perceptions of community college adjunct faculty and division chairpersons: Support, mentoring, and professional development to sustain academic quality. *Community College Journal of Research and Practice*, 37(8), 596–607. doi: 10.1080/10668926.2012.720863
- Dolan, V. L. B. (2011). The isolation of online adjunct faculty and its impact on their performance. *International Review of Research in Open and Distance Learning*, 12(2), 62–77. doi: 10.19173/irrodl.v12i2.793

- Fagan-Wilen, R., Springer, D. W., Ambrosino, B., & White, B. W. (2006). The support of adjunct faculty: An academic imperative. *Social Work Education, 25*(1), 39–51. doi: 10.1080/02615470500477870
- Forbes, M. O., Hickey, M. T., & White, J. (2010). Adjunct faculty development: Reported needs and innovative solutions. *Journal of Professional Nursing, 26*(2), 116–124. doi: 10.1016/j.profnurs.2009.08.001
- Frederickson, C. (2015, September 15). There is no excuse for how universities treat adjuncts. *The Atlantic*. Retrieved from <https://www.theatlantic.com/business/archive/2015/09/higher-education-college-adjunct-professor-salary/404461/>
- Fura, L. A., & Symanski, M. E. (2014). An online approach to orienting clinical nursing faculty in baccalaureate nursing education. *Nursing Education Perspectives, 35*(6), 324–326. doi: 10.5480/12-868.1
- Gappa, J. M., & Leslie, D. W. (1993). *The invisible faculty*. San Francisco: Jossey-Bass.
- Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutrition Education and Behavior, 47*(1), 109–114. doi: 10.1016/j.jneb.2014.08.008
- Gottshall, D. B. (1993). *The history and nature of the Great Teachers Movement*. Glen Ellyn, IL: College of DuPage.
- Huberman A. M., & Miles, M. B. (2000). Data management and analysis methods. In N. K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 428–444). Thousand Oaks, CA: Sage.
- Jaschik, S. (2010, June 21). Adjuncts and retention rates. *Inside Higher Ed*. Retrieved from <https://www.insidehighered.com/news/2010/06/21/adjuncts-and-retention-rates>
- Kelly, D. K. (1990). A human resources development approach to part-time faculty. *Proceedings from the National Conference on Professional Development of Part-Time Occupational/Technical Faculty*, 131–138. Office of Vocational and Adult Education: Washington, DC. Retrieved from <https://files.eric.ed.gov/fulltext/ED326294.pdf>
- Kemery, D. C., & Serembus, J. F. (2019). An innovative approach to onboarding and supporting adjunct faculty in nursing. *Nursing Education Perspectives, 40*, 4. doi: 10.1097/01.NEP.0000000000000353
- Kuh, G. D. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter*. Washington, DC: AAC&U.
- Leitzel, T. C. (1990). Implementing a team-teaching approach for part-time faculty development. *Proceedings from the National Conference on Professional Development of Part-Time Occupational/Technical Faculty*, 140–148. Office of Vocational and Adult Education: Washington, DC. Retrieved from <https://files.eric.ed.gov/fulltext/ED326294.pdf>
- Leslie, D. W., & Gappa, J. M. (2002). Part-time faculty: Competent and committed. In C. Outcalt (Ed.), *Community college faculty: Characteristics, practices, and challenges* (pp. 59–67.) San Francisco: Jossey-Bass.

- Luna, G. (1990). Helping part-time faculty become part of the team: Professional development through mentoring. *Proceedings from the National Conference on Professional Development of Part-Time Occupational/Technical Faculty*, 173–180. Office of Vocational and Adult Education: Washington, DC. Retrieved from <https://files.eric.ed.gov/fulltext/ED326294.pdf>
- Lyons, R. D., & Burstad, H. (2007). *Best practices for supporting adjunct faculty*. Boston: Anker.
- Lyons, R. E., & Kysilka, M. L. (2000, May). A proven program for developing adjunct community college faculty. *Paper presented at the Annual International Conference on Teaching and Leadership Excellence*, Austin, TX.
- Maldonado, E., & Riman, J. (2009). The adjunct advocate@Fit: Bringing part time faculty into the mainstream. *Journal of Educational Technology Systems*, <https://doi.org/10.2190/ET.37.3.h>
- Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical step-by-step guide for learning and teaching scholars. *All Ireland Journal of Teaching and Learning in Higher Education*, 8, 3, 3351–33514. Retrieved from <http://ojs.aishe.org/index.php/aishe-j/article/view/335/553>
- Major, C. H., Harris, M. S., & Zakrajsek, T. (2016). *Teaching for learning: 101 intentionally designed activities to put students on the path to success*. New York: Routledge.
- Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, 90, 227–234.
- National Center for Education Statistics. (2012). *Digest of education statistics, Winter 2011-12, Human Resources Component, Fall Staff Section: Table 286* [data file]. Washington, DC: Institute of Education Sciences. Retrieved from http://nces.ed.gov/programs/digest/d12/tables/dt12_286.asp
- Palacio, C. G., Vargas, D. E., & Taborda, H. P. (2019). Coaching as a professional development strategy for adjunct instructors in a Columbian university. *Profile Issues in Teachers' Professional Development* 21(1), 121–135. doi: 10.15446/profile.v21n1.71326.
- Pete, E. (2016). *Online training impact on adjunct faculty compliance and satisfaction with professional development*. (Doctoral dissertation). Retrieved from <https://scholarworks.waldenu.edu/dissertations/2041/>
- Phillippe, K. A. (2000). *National profile of community colleges: Trends and statistics* (3rd ed). Washington, DC: Community College Press.
- Roueche, J. E., Roueche, S. D., & Milliron, M. D. (1995). *Strangers in their own land: Part-time faculty in American community colleges*. Washington, DC: Community College Press.
- Saginaw Valley State University. (2012, April). The importance of faculty development. *In the Loop*. Office of Adjunct Faculty Support Programs. SVSU. Retrieved from: <http://www.svsu.edu/library/archives/public/InTheLoop/documents/ITL2012/ITL201204.pdf>
- Schneider, J. M. (2004). Employing adjunct faculty from a HR perspective. *Phi Kappa Phi Forum*, 84(4), 18–19.
- Shattuck, J., Dubins, B., & Zilberman, D. (2011). MarylandOnline's inter-institutional project to train

higher education adjunct faculty to teach online. *International Review of Research in Open and Distance Learning*, 12(2), 40–61.

Sorcinelli, M. D., Austin, A. E., Eddy, P. L., & Beach, A. L. (2006). *Creating the future of faculty development: Learning from the past, understanding the present*. Boston: Anker.

United States Department of Education. (2013). *Trends in faculty employment status, 1975-2011*. National Center for Education Statistics, IPEDS Fall Staff Survey. Retrieved from https://www.aaup.org/sites/default/files/Faculty_Trends_0.pdf

Wallin, D. L. (2010). Valuing professional colleagues: Adjunct faculty in community and technical colleges. *Community College Journal of Research and Practice*, 28(4), 373–391. doi: 10.1080/10668920490424087

Yin, R. K. (2018). *Case study research and applications: Design and methods*. Thousand Oaks, CA: Sage.

Author

Colleen Packer, Ph.D, is a professor in the Department of Communication and the Director of the Teaching and Learning Forum at Weber State University, Ogden UT, USA. Her research interests focus on educational development and the scholarship of teaching and learning.

Appendix A: Adjunct Retreat Survey

Demographic Questions

1. How many years have you taught as an adjunct at Western University?
2. Please select the college in which you do the majority of your adjunct teaching.
3. Please list the department(s) for which you do your adjunct teaching.
4. I have attended the adjunct retreat in the past.

Format Questions: Please select the degree to which you agree with the following statements in regard to the new format for the retreat. For the purposes of these questions, the new format refers to adjuncts interacting with each other and with facilitators while the previous format refers to keynote speakers with break-out sessions.

1. This format helped my learning more than the previous format.
2. This format enhanced my teaching effectiveness more than the previous format.
3. This format helped me connect with other adjuncts more than the previous format.
4. This format helped me connect with at least one full-time faculty member more than the previous format.
5. This retreat helped me feel more connected to the Western University community than the previous format.
6. I prefer this format over the previous format.

Connection Questions: Please indicate your level of agreement with the following statements about the impact of the Adjunct Retreat on helping you connect with other faculty.

1. The adjunct retreat provided me with an opportunity to network and connect with other adjunct instructors.
2. The adjunct retreat provided me with an opportunity to network and connect with at least one full-time faculty member.

3. The adjunct retreat strengthened my connections to the institution.
4. As a result of participating in this retreat, I feel like I am part of a teaching community.
5. This retreat helped me feel connected to the Western University community.

Instruction & Pedagogy Questions: Please indicate your level of agreement with the following statements about the impact of the Adjunct Retreat on your pedagogy.

1. I experienced a variety of pedagogical strategies through my participation in today's event.
2. I learned new teaching strategies that I can use immediately in my classroom.
3. I learned new skills that I can use to improve my teaching.
4. At this retreat, I learned strategies to increase student-faculty contact.
5. At this retreat, I learned strategies to increase cooperation among students.
6. At this retreat, I learned strategies to encourage active learning.
7. At this retreat, I learned strategies to implement prompt feedback.
8. At this retreat, I learned strategies to increase student time on task.
9. At this retreat, I learned strategies to communicate high expectations.
10. At this retreat, I learned strategies to respect diverse talents and ways of learning.
11. Identify at least one new strategy that you can use immediately in your teaching as a result of this event.

Additional Open-Ended Questions

1. Tell us about your best experience at this event.
2. What suggestions do you have to improve other events like this in the future?
3. What tools or support do you need to be successful as an adjunct instructor at Western University?

THE USEFULNESS OF TECHNOLOGY IN TEACHER PROFESSIONAL DEVELOPMENT: EXTENDING THE FRAMEWORKS

Dragana Martinovic
University of Windsor, Canada

Yifat Ben-David Kolikant
The Hebrew University of Jerusalem, Israel

Marina Milner-Bolotin
University of British Columbia, Canada

Abstract: *We describe three major challenges that teachers of STEM subjects face in their preparation and practice. Then, we discuss how technology could become a vehicle for providing timely and content-related support. To this end, we suggest a theoretical framework, which builds on the works of Vygotsky, Shulman, and Mishra and Koehler. Specifically, we use the notion of zone of proximal development to accentuate educators' professional growth and ideas from the activity theory to put educators' deliberate actions and learning in the wider context of peer learning. Then, we use this framework to describe two professional learning models, each from a different STEM field. This paper will be of interest to STEM educators and facilitators of professional learning activities, as well as developers of education technology resources.*

Key words: STEM teachers, professional development, education technology

Introduction

The 21st Century Challenges

In the second decade of the 21st century, mathematics and science teachers and teacher-educators faced tough challenges. **The first challenge** is a growing dissatisfaction of the general public and the governments with the mathematics and science education in our public schools. While governments ask for improved student scores on international assessments and for skills adequate for future workplace, media and parents ask for *back-to-basics* (OECD, 2016a, 2016b). The rapidly changing demands for teachers, oscillating between the calls for back-to-basics and improved scores on standardized testing versus the calls to incorporate inquiry-based learning and

encourage creativity, critical thinking, and other soft skills, even if it means a reduced emphasis on the development of content-specific skills and abilities, are especially taxing for new teachers (British Columbia Ministry of Education, 2015; Kennedy, 2016; OECD 2016a). These ongoing curricular reform fluctuations have significant implications for students, parents, and of course, teachers (Cuban, 1990; Fullan, 2007).

This problem is exacerbated by **the second challenge**—the growing diversity of the student population and the limited opportunities modern families have for supporting the academic studies of their children outside of school. It happens for many reasons, including parents' increased work commitment, their limited academic background or language proficiency, or the

lack of parents' familiarity with the school curricular demands (Milner-Bolotin, 2017). While this challenge has implications for all school subjects, mathematics and science are especially affected (Van der Zalm, 2010). These subjects have a hierarchical structure and require a solid foundation, dedication, significant time investment, and appreciation from both students and parents.

The third challenge is related to the emergence of the science, technology, engineering, and mathematics (STEM) field. With the blurring of the subject and discipline boundaries, mathematics and science are now often placed under the STEM education umbrella, whereby teachers are expected to be able to draw curricular connections between the subjects. This challenge is even more critical in the countries like Finland, in which the curriculum integration is a compulsory part of the new curriculum (Niemelä & Tirri, 2018). Without proper support, this expectation is certain to get teachers out of their pedagogical comfort zone.

The implications of these challenges on teacher education and professional development (PD) are still unclear (Ben-David Kolikant, Martinovic, & Milner-Bolotin, 2019; also see OECD, n.d., 2030 project). Moreover, with the rapidly changing K-12 STEM-related curricula around the world, inclusion of new subjects and subject areas such as computer science, computer programming, robotics, environmental science, computer modelling, and technology education, mathematics and science teachers may be expected to teach less familiar content and use pedagogical approaches that they did not have a chance to experience as students (Lieberman, Ben-David Kolikant, & Beeri, 2012; Martinovic & Manizade, 2014; Martinovic & Zhang, 2012). Because the latest curricula also put more emphasis on competency-based assessment (e.g., British

Columbia Ministry of Education, 2015; Ontario Ministry of Education, 2014, 2016), teachers must refocus their assessment practices and reconsider how they evaluate student learning outcomes (Milner-Bolotin & Moll, 2008).

The Need for Different PD and the Potential of Technology

In order to address these challenges, teachers need ample support in the form of mentorship, accessible teaching communities of practice, and ongoing PD. However, in many developed countries teachers still have limited access to ongoing and on-demand PD, such that is relevant to their contexts, local curricula, pedagogical and technological innovations they are trying to implement, and personal needs. There is ample research evidence that the traditional practice of an intermittent and piecemeal PD is ineffective (Darling-Hammond, Hyler, & Gardner, 2017, Fullan, 2011; Opfer & Pedder, 2011; Phillips, 2014; Smylie, 2014; Trust, Krutka, & Carpenter, 2016; Wei, Darling-Hammond, & Adamson, 2010). In this practice, the teachers spend a handful of PD days a year outside of their classrooms participating in activities imposed by their administration. Beyond these sporadic PD days where they can meet and discuss with their peers, teachers often work in isolation getting limited mentorship or support for implementing these educational innovations in their classrooms. With the current climate of reduced educational funding in Canada and elsewhere, it would be unrealistic to expect that teachers' access to relevant face-to-face PD opportunities will improve dramatically in the near future.

The persistent failure to address these challenges has motivated us to examine the role of modern educational technology in providing meaningful PD for teachers. Despite the proliferation of digital technology

in everyday life and in schools and its increased social value, these novel tools are yet to be utilized deliberately to enhance STEM teacher PD (Milner-Bolotin, 2016; OECD, 2016a). In fact, the success of innovative PD programs in the 21st century depends on different factors. These factors include but are not limited to teachers:

(1) ability to benefit from online collaborative PD forums; (2) mastery of the variety of problem-solving strategies for resolving conflicts related to their local school environment; and (3) prior conceptions about teaching and learning, and the compatibility of these concepts with the reformed instructional pedagogy. (Russell & Schneiderheinze, 2005, p. 38)

Russell and Schneiderheinze (2005) observed four teachers who “had the same amount of technology, software and hardware, and the same amount of previous [technology] training” (p. 42). The authors found that each teacher approached and benefitted from online PD in a unique way. Some reasons for such a variety were internal, such as having “differing beliefs about the learning potential resulting from the unit [and] differing abilities to collaborate and problem-solve as innovators”; while some were external, such as dealing with “differing context issues” (p. 42) at their workplace. However, the commonality was that none of the teachers used the online environment to its full potential, neither for collaborating with peers nor for working with students. The researchers recommended that teachers’ prior experiences with technology, local school community, and pedagogical conceptions must be taken into account in developing any similar program. Although the research evidence supports the claim that the most promising innovations that strive to improve teaching do so by improving collaboration and peer learning between teachers (Fullan, 2011; Winthrop, McGivney, Williams, &

Shankar, 2016), this aspect is difficult to accomplish.

What Do 21st Century Teachers Need to Know?

Nowadays, it is widely accepted that all workers should be critical thinkers and problem solvers; team players and collaborators; technology users, and self-directed and lifelong learners (Partnership for 21st Century Skills, 2006). Additionally, educators need to be role models as creative and flexible thinkers; seekers of emergent possibilities; reflective and informed practitioners, who continually plan, implement, assess, and innovate (Literacy and Numeracy Secretariat, 2010). In this context, being informed practitioner means knowing the subject and being well-informed in the educational advancements and curricula.

Beijaard, Verloop, and Vermunt (2000) described teachers’ professional identity as a blend of three aspects: subject-matter expertise, pedagogical expertise, and didactical expertise. Compared to secondary school teachers, who are most often subject-matter specialists, elementary school teachers are for the most part generalists making development of this aspect of professional identity particularly difficult. This issue was raised by Shulman (1986) more than three decades ago when he pointed out to the *missing paradigm problem* that is especially prevalent among elementary school teachers. The second aspect, pedagogical expertise (Beijaard et al., 2000), relates to the ideas of how people learn and what pedagogical approaches could facilitate their developmental trajectories. The third aspect, didactical expertise, relates to knowing how to assist learning of the specific subject (i.e., pedagogical content knowledge [PCK]; Shulman, 1986). However, it has been well established that teachers benefit less from

receiving prescribed knowledge, as compared to personalized approach from someone who knows what the teachers are experiencing and who can make the PD relevant to them. The teachers appreciate guidance on the enactment of the content knowledge, a format that yet has to be adopted across the system as the PD programs still largely address general pedagogical prescriptive issues, while paying less attention to the subject-specific pedagogical knowledge and teachers' intellectual engagement (Kennedy, 2016; Phillips, 2014).

A Novel Theoretical Framework for Teacher Professional Growth with Technology

The theoretical framework suggested here builds upon Milner-Bolotin's (2016) framework termed *deliberate pedagogical thinking with technology* (DPTwT). The DPTwT highlights the role of educational technologies in the initial development of physics teachers' professional knowledge. It relies on the notions of technological pedagogical content knowledge [TPCK] (Mishra & Koehler, 2006) and the zone of proximal development [ZPD] (Vygotsky, 1978). To these, we added aspects of activity theory, which enabled us to extend the DPTwT beyond the intended physics teachers' professional knowledge to include the mathematics and science with technology.

Technological Pedagogical Content Knowledge

During the last half a century, education researchers have suggested multiple conceptual frameworks to describe professional knowledge of teachers. It started with Shulman (1986) who proposed that pedagogical content knowledge (PCK) is what distinguishes teachers from other professionals. The PCK is a combination of the subject-specific content knowledge (CK)

and the general pedagogical knowledge (PK). The PCK was later expanded to include the knowledge of educational technologies, technological knowledge (TK), thus morphing into the TPCK (Mishra & Koehler, 2006). The latter framework separates the CK (i.e., the knowledge of specific STEM disciplines) from the knowledge of how these subjects could be taught in the K-12 context (PCK), and the knowledge of how technology could be used to enhance student learning of the discipline in the context (TPCK). While CK is usually acquired by future teachers during their undergraduate studies, PCK and TPCK develop during teacher education and different forms of professional lifelong learning.

Zone of Proximal Development

Soviet psychologist Lev Vygotsky (1896-1934) noticed that children have a potential to learn more when they are supported by peers or adults. He called the difference between what children can do unassisted and what they can do while assisted, as ZPD. To take a full advantage of one's ZPD and to expand one's knowledge and skills, the social environment should provide scaffolds of learning.

In the literature, the concept of ZPD was extended to any learning situation, as well as to "the training of adults to learn complex tasks frequently encountered in the use of information systems" (Verenikina, 2003, p. 6). Holzman (2006) noted that "unlike young children, adults need the added support of conceptual learning, of stepping back and abstracting the 'lessons learned' from ... experiential learning activities" (p. 21). This is especially relevant for teachers, who must always learn, update and question their knowledge, interact with others in the field, and continuously reflect on their practice. The view of ever-evolving mastery of teaching and the importance of a community in

becoming and being an effective teacher is situated in Vygotsky’s ideas:

Vygotsky saw human growth as a cultural activity that people engage in together, rather than as the external manifestation of an individualized, internal process or the lawful pattern of responses to external stimuli. Growth and transformation don’t happen *to us*; we create them. In both his research and theorizing, Vygotsky presented a new methodology for understanding human life as lived, with a particular focus on child development, learning and teaching as collaborative, creative, cultural activities of continuous transformation. (Holzman, 2006, pp. 9–10; emphasis in original)

Deliberate Pedagogical Thinking with Technology

The notion of continuous transformation through collaborative learning and teaching activities (Holzman, 2006) is the crux of the DPTwT (see Figure 1). It was originally developed to describe the growth of TPCK (Mishra & Koehler, 2006) of science teachers as a result of their engagement with educational technologies and other educators. It used the ZPD (Vygotsky, 1978) to emphasize the role of peers in professional learning and define the teacher ZPD (T-ZPD) as the gap between what a teacher has already mastered (the actual level of development, as expressed by their current TPCK) and what they can achieve when provided with opportunities to collaborate with peers and more experienced educators. Through collaboration, teachers’ TPCK can grow much more effectively than had they worked in isolation.

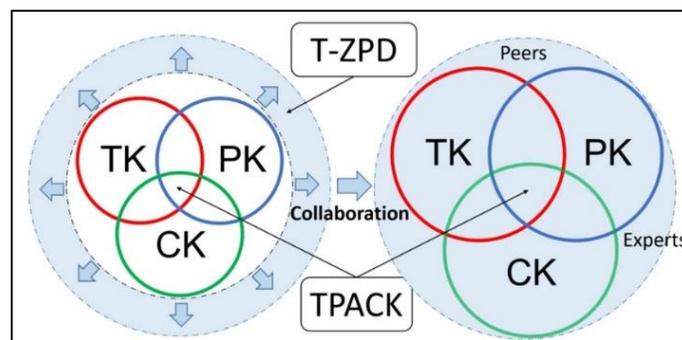


Figure 1. DPTwT framework (Milner-Bolotin, 2016)

The DPTwT framework is built on five major assumptions about the multi-faceted nature of teachers’ knowledge for teaching; it is

1. based on PCK (Shulman, 1986), knowledge of psychology and of the science of learning, as well as on pedagogically sound use of modern technologies;

2. subject- and context-specific, thus, elementary and secondary teachers might possess different kinds of knowledge, and the same can be said about teachers from different subject areas, cultures or geographic areas;
3. continually evolving— teachers’ professional knowledge can grow and expand during their careers, but it also can

diminish (or die) if they stop learning. Aligned with Carol Dweck’s (2006) idea of growth mindset, teachers are foremost learners whose professional knowledge can thrive in a supportive learning environment;

4. acquired through academic studies, professional practice, reflection, and collaboration with colleagues, students, and parents; and
5. necessary but insufficient for successful teaching practice, as it has to be coupled with appropriate attitudes and dispositions that comprise educator’s teaching philosophy.

Extending the DPTwT Framework

The extended DPTwT framework is the result of our analysis of the original DPTwT components, based on which we revised the original diagram (see Figure 2). It is important to mention that while this framework was initially applied to STEM teacher education, it can be applied to other subjects. We identified four aspects, which need to be considered in planning and executing PD programs. These are (a) focusing on specific types of technologies, (b) focusing on growth of TPCK, (c) balancing TPCK components, and (d) creating supportive environments.

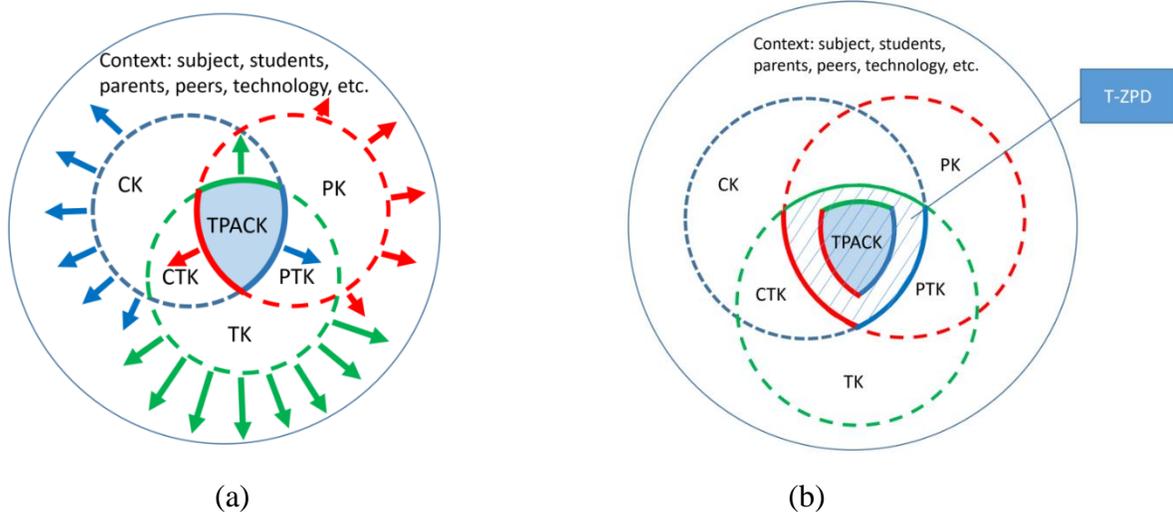


Figure 2. (a) Extended DPTwT framework focuses on the growth of TPCK through peer collaboration in a technology-supported community of practice; (b) different facets of teacher professional knowledge grow at different rates causing the overlap (TPCK) to grow as well.

Focusing on specific types of technologies.

To avoid danger of bringing too many different kinds of technologies under the unified technology umbrella, we consider as especially relevant the subject-specific technologies, such as calculators, computers, and digital sensors, as well as communication technologies, such as computer networks. While the former may be used synchronously in individual or group work, the latter ones

also allow for asynchronous exchange of information and collaboration at distance. Consequently, the extended DPTwT framework considers technology as both a tool that can support teachers in deliberately promoting student learning, using subject-specific technologies, such as GeoGebra or PhET, and as tools that can promote teacher collaboration and PD (through Skype, Google Hangouts, social media tools, etc.).

Focusing on growth of TPCK. Each of the teacher professional knowledge facets (CK, PK, and TK) can grow at different rates, but as they grow, it is important to ensure that the overlap between them—the TPCK grows as well. Our experience tells us that the boundaries of each facet of teacher professional knowledge are porous, which signifies that in a professional learning situation it is almost impossible to address one kind of knowledge without affecting the others. Partially, the problem lies in the TPCK framework, for which the validation studies suggest “that measuring each of [the subdomains, e.g., PK, CK, and TCK] is complicated and convoluted, potentially due to the notion that they are not separate” (Archambault & Barnett, 2010, p. 1556). Additionally, teachers are required and known to be reflective individuals who relate every situation to their teaching practice. For example, the PD event may discuss assessment and working with specific populations of students (e.g., children with special needs) without having an explicit intent to expand the knowledge of the discipline (CK). However, with the increase of the PCK, there will be some positive effects on the understanding of concepts as well. Alternatively, the workshop facilitator may use technology during the workshop to demonstrate how children learn using it, and although the TK is not a target, the teachers’ TCK will be increased, which will positively affect their TK. Of course, that does not mean that any PD with technology would do.

Balancing TPCK components. With the idea that teachers’ PD should address TPCK, and take into account the educators’ and children’s needs, each of the CK, PK, and TK

should be dealt with to some extent. However, this would only work if the PD facilitators address the TPCK, while consistently:

- using non-trivial examples from the discipline that are clearly related to the curriculum. Using trivial examples, as it is often done, will not only fail to increase one’s CK, but will be de-motivating; the same goes to using examples that are too difficult or those that are far-removed from the curriculum;
- using various kinds of up-to-date technology that is available to teachers and students. For example, using free smartphone apps or software that teachers and students have free access to (Maciel, 2015);
- attempting to match pedagogy with technology and content. Failing to do so has negative consequences. For example, insisting on individual work and preventing students to work in groups, does not align with the best practices to learn mathematics and does not use the advantages of collaborative technologies available in schools.

Creating supportive environments. To provide adequate scaffolds through a collaborative and technology-based professional learning, the extended DPTwT framework borrows from Engeström’s (1987) version of the activity theory, which included the components of community, division of labor, and rules (see Figure 3). It emphasized that the professional learning is an activity that uses the intelligence of others—evident in tools, discourse, and communal supports—as a lifeline.

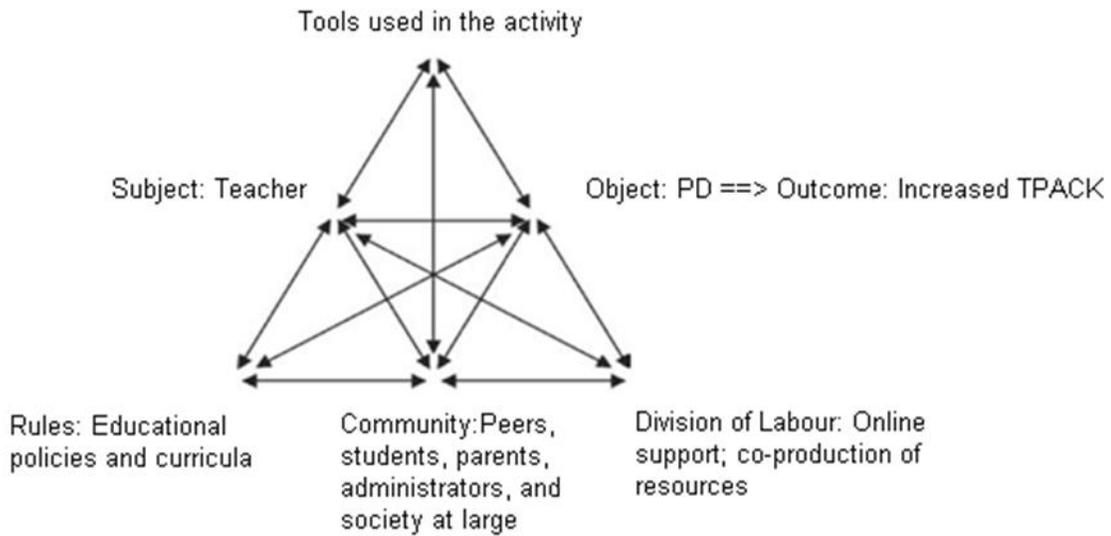


Figure 3. Engeström’s (1987) model applied on a supportive professional learning environment.

The upper triangle of Figure 3 can present the activity of individual teachers, which results in their increased TPACK (i.e., the outcome). Teachers’ growth is mediated by the tools they use, as Jonassen and Rohrer-Murphy (1999) stated, “tools mediate or alter the nature of human activity and, when internalised, influence humans’ mental development” (p. 66–67). Tools could be material objects but also symbols, signs, images, language, and technology (Martinovic, Freiman, & Karadag, 2013). The lower part of the triangle represents activity as influenced by interactions with peers, students, parents, administrators, and the society at large. The rules include the policies and the curricula. The arrows exemplify relationships and influences. Edwards (2007) pointed out that “new forms of [professional] practice are being required which call for a capacity to work with other practitioners and draw on resources that may be distributed across systems to support professional actions” (p. 1). Edwards called this capacity relational agency and defined it:

As a capacity [relational agency] can be learnt and elicited in different situations. It is not embedded in existing relationships and carefully designed pedagogic zones of proximal development but may emerge in both formal and informal settings and with people who are known and as yet unknown. It allows us to work with others in pursuit of ever expanding objects and to explore the possibilities that these new objects reveal. (p. 6)

In summary, the extended DPTwT framework views teacher knowledge as evolving through collaboration with peers, mediated by the use of technologies. This extended framework also emphasizes different dimensions of teachers’ knowledge and their overlaps that contribute to the formation of this very specialized professional knowledge, in our case—the knowledge for teaching STEM subjects (see Figure 2).

Using Extended DPTwT Framework to Examine Learning in the Existing Teacher Education and PD Models

In this section, we introduce two PD models with educators teaching STEM subjects and analyze them using the extended DPTwT framework.

UBC Online M.Ed. in Science Education Program

The University of British Columbia offers an online M.Ed. in Science Education program (UBC Faculty of Education, 2019). The program has been designed as a sustained PD opportunity for practicing K-12 teachers of science in order to bridge educational research and practice, while engaging teachers in an education community facilitated by university educators and researchers. Its courses are limited to 20 participants in order to create a vibrant online community. The program also operates in a cohort form and usually takes two years and one semester to complete, as most of the participants are also part-time or full-time educators and are not expected to take more than two online courses per term. In addition to completing all the coursework, the participants must write a graduating paper or create an online portfolio reflecting how the theoretical knowledge they acquired in the program could enhance their professional practice.

This program uses educational technology in multiple ways. First, it uses it to create a collaborative learning environment for teachers who are located in different parts of the country and could not have met face-to-face. Collaboration is supported by an online course management platform, while utilizing online collaboration tools such as Collaborate Ultra, Google Hangouts, Skype, etc. The focus on creating a community of learners is deliberate. Technology helps teachers to get

to know and feel comfortable with each other, identify each other's strengths and weaknesses, and feel open to reaching out and collaborating. Thus, it becomes a mediating tool for supporting peer learning through collaboration.

Second, this technology-enabled learning community of teachers opens opportunities for identifying and expanding different facets of knowledge for teaching of individual educators through utilizing their individual T-ZPD. Some teachers in the program have extensive PK, CK, or PCK, while others might have more knowledge of technologies and their pedagogical applications.

Third, having elementary and secondary educators in one cohort opens opportunities for collaboration on science education that rarely happen, as these teachers traditionally have limited communication with each other. All the courses in the program emphasize collaboration and reflection, while providing educators with many opportunities to experience educational technologies as learners, reflect on them as teachers, and attempt to implement them in their own classrooms, as practitioners (Milner-Bolotin, Fisher, & MacDonald, 2013). This facilitates the growth of different aspects of teachers' professional knowledge.

Fourth, this online program invites the participants to experience various educational technologies in the context relevant to their own teaching, collaborate and learn from and with each other, and provide and receive feedback from peers and the course instructors (Milner-Bolotin, 2015). This approach deliberately aims at utilizing teachers' T-ZPD for the purpose of growth of their professional knowledge. It is especially important, as the program includes experienced as well as relatively new teachers, so both groups can benefit from online collaboration.

Finally, the courses in the program examine research methods in education, science teaching and learning with technology, design and evaluation of technology-enhanced science learning environments, as well as specific educational technologies and educational assessment (Milner-Bolotin, 2016). The choice of courses allows program facilitators to capitalize on teachers' strength and help address their weaknesses. For example, one of the courses titled, *Mathematics and Science Teaching and Learning through Technologies*, invites teachers to experience different educational technologies and design relevant technology-based PD events they can implement in their schools.

In summary, technology is used deliberately throughout the M.Ed. in Science Education program to promote pedagogies suitable for active engagement of graduate students and, along, modeling active engagement of students in elementary and secondary schools (Milner-Bolotin, 2016). Continuous reflection, feedback from peers and multiple iterations of the assignments, as well as using technology for enabling ongoing teacher collaboration, facilitate the evolution of teachers' professional knowledge for teaching science (Milner-Bolotin, 2019).

Online Professional Learning of Mathematics in Ontario

In 2017-2018, the Ontario Ministry of Education personnel (most of whom were previously in the leadership and administrative positions in their districts) led the educators' professional learning of mathematics in a program called, The Math Pod. They used social media (e.g., on-line radio program, project website, and Twitter; Brown, 2012) to create opportunities for professional "learning and knowing as situated, social, and distributed" (Putnam & Borko, 2000, p.5). This was done in the

context in which each elementary school was required to have 1-3 Math Leads tasked with supporting their peers in delivering curriculum content.

There were three rounds of The Math Pod each lasting four weeks. More than 800 participants signed up for the sessions. The online environment and multimedia materials mediated the exploration of carefully selected ideas for teaching mathematics. The labour was distributed between the facilitators who run the segments, interviewed guests, posted materials, and maintained the project website; guests who answered questions and offered supports; and participants who tweeted their classroom examples, asked questions, or provided advice and feedback. The researchers worked in the background, collecting data to inform the next round of this or other similar PD and to create summaries of activities for the project website. Relational agency of all was elicited, as this type of PD would not work without those involved having "capacity to offer support and to ask for support from others" (Edwards, 2007, p.1).

Overall, the educators positively evaluated contribution of The Math Pod to their learning, especially to their understanding of how to learn and teach mathematics. On average, the participants agreed with the statement, "I feel that the Math Pod activities made me more 'intentional' in my teaching and/or leadership of mathematics" (Donsky & Martinovic, 2018).

Modern Technology Contributions to Teaching as Viewed through DPTwT Framework Lens

The two examples provided above emphasize the role technologies could have in the educators' continuous professional learning. In the era of reforms and limited funds to support PD, using online opportunities for

formal (e.g., UBC online MEd in Science Education program) or informal professional learning (e.g., The Math Pod), is both cost-effective and suitable. For Westera (2005), the only option in which education could “meet the continually changing needs of society [is through] sensible application of new technologies” (p. 35). However, how can teacher educators do that? Achieving this task is not easy. Education practices are still for the most part intrinsically conservative, traditionally following a business model of “one man shops” (Westera, 2005). Teachers tend to work in isolation and behind the closed classroom doors. These isolation-oriented practices stifle innovation and are counterproductive with respect to the DPTwT (Milner-Bolotin, 2016) framework.

Also, we should be mindful that *more* does not automatically mean *better*. For example, the Ontario professional learning experience prior to The Math Pod utilized a variety of the latest technological options (e.g., a live radio show and its podcast recordings; Twitter; a book and its Facebook study group; items posted on the Google+ Groups; personal and collaborative blogs; quad blogs; and a newsletter) encouraging

- a. open online conversations on multiple platforms,
- b. documentation of learning shared openly in multiple formats, and
- c. scaffolded access to artefacts of learning through a single open access point (a website).

Sixteen out of 35 educators who completed the online exit survey reported having hard time to participate in activities. The respondents claimed to have spent on average 2.9 hours per week on this project (min = 1.5 h, max = 8 h). Many reported being challenged with using online technologies, and specifically navigating the many options that were provided to them. A group of educators advanced that they were lost at the

beginning of the process before figuring out how to engage in the best way that fits their preferences. One educator wrote

I found it extremely difficult to keep track of all the options, email, and newsletters. I would prefer communication from one source with all information in one resource. I feel that a 1 hour/week commitment turned into several hours over different days/time which I was unable to attend. As a result, I felt ‘out of the loop’ and disconnected from the process. I’m struggling with the work flow of Twitter. In order to add this to my day, I will have to remove something else. I’m not sure of the value of having people retweet my ideas or me retweeting others’ ideas. It can be flattering but I cannot say that anything that I have read on Twitter has changed my practice.

Despite these criticisms, most of the participating educators were satisfied with the overall learning experience, and 75% said that in the future they intend to participate in the similar professional learning. In their feedback, they suggested trimming the number of online features and concentrating on the most efficient ones. They mentioned that they learned how to use some technologies (e.g., blogs), but because of the intensity of communication and the number of online options, they felt intimidated to use these new features. They did not express the need to gain new technological skills, but rather to use those that provide the highest reward in terms of extending their PCK. One educator suggested to “include video conferencing options for on-line learning [being able to see the speakers in the radio show] or being on-line with a particular group of learners at a pre-arranged time,” while another expressed a need for “more practical resources to use. Coaching scenarios. Vignettes. Getting at real problems teachers are facing.” While they could not address all

the feedback in The Math Pod that followed, the facilitators provided a smaller variety of features (i.e., live radio show accompanied with Twitter chats, and followed by reflective blogging), but encouraged their use by all.

Conclusions and Recommendations

The potential of technology to support online professional learning and peer networks is well established. Preparing and supporting teachers who are ready and willing to take advantage of the 21st century opportunities to succeed in the current reality of increased expectations and frequent reforms is challenging; technology could be better used by educators in both micro (e.g., classrooms), meso (e.g., school-wide), and macro (e.g., province-wide or even country-wide) applications. To address both old and new challenges, teacher educators and PD organizers could provide both formal and informal professional learning options to teachers, using the extended DPTwT as a beacon. The extended DPTwT combines several powerful theories in order to show how these programs could be structured and researched.

The PD organizers should take into account their audiences and be deliberate in selecting not only activities but technologies as well. If the goal is to spread out the message, to inform, the most commonly used technology, such as Twitter, may be appropriate. If the goal is to gain a pedagogical or content-related skill, employing the technology that all can have access to and a good portion of participants have experienced at some point, is suitable. This will allow for more experienced peers to guide the newbies, whose ZPD will extend. Those in supporting roles will extend their T-ZPD because they will be providing scaffolds to others, sometimes in a similar way as to their students. Facilitators will have to differentiate activities and technologies to keep their

participants interested making sure they extend their ZPD. Sometimes providing extra activities (both advanced and simpler) may help but also not trying to challenge the audience in all three—PK, CK, and TK—at the same time. Instead, being very intentional in diversifying activities so that in one session, participants practice a progressive PK, while using the CK and TK at their comfort level; while in the next session, they engage in the activity extending their CK, while utilizing known PK and TK, and so on.

Online communication and access to online repositories of educational resources should be utilized to provide just-in-time support for teachers and teacher educators. Teachers are very busy and may need support in order to consider and adopt teaching methods they did not experience as students. Therefore, combining the educational materials (e.g., lesson plans, instructions) and video testimonials from those who used them with vignettes from the classrooms, as well as discussion forums/Twitter feeds might be very helpful to provide both informational and emotional support to teachers. After all, success in supporting STEM (and other) educators in the era of frequent curriculum reforms, intensified globalization, and breakthroughs in science and technology will require more work on extending their relational agency (Edwards, 2007). We call on teacher educators to consider how we can address contemporary educational challenges through creative use of technology in STEM teacher education and professional development.

References

- Archambault, L. M., & Barnett, J. H. (2010). Revisiting technological pedagogical content knowledge: Exploring the TPCK framework. *Computers & Education*, 55, 1656–1662. doi: 10.1016/j.compedu.2010.07.009
- Beijaard, D., Verloop, N., & Vermunt, J. D. (2000). Teachers' perceptions of professional identity: An exploratory study from a personal knowledge perspective. *Teaching and Teacher Education*, 16, 749–764. doi: 10.1016/S0742-051X(00)00023-8
- Ben-David Kolikant, Y., Martinovic, D., & Milner-Bolotin, M. (Eds., forthcoming 2019). *STEM teachers and teaching in the digital era - Professional expectations and advancement in 21st century schools*. Berlin: Springer.
- British Columbia Ministry of Education. (2015). Building students success: BC's new curriculum. Retrieved from <https://curriculum.gov.bc.ca/>
- Brown, E. (2012, January 19). Teachers take to Twitter to improve craft and commiserate. The Washington Post. Retrieved from http://www.washingtonpost.com/local/education/teachers-take-to-twitter-to-improve-craftand-commiserate/2012/01/19/gIQAGv8UGQ_story.html.
- Cuban, L. (1990). Reforming again, again, and again. *Educational Researcher*, 19(1), 3–13. doi: 10.2307/1176529
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Palo Alto, CA: Learning Policy Institute.
- Donsky, D., & Martinovic, D. (2018-Fall). The Math Pod - learning mathematics one podcast at a time. In Christina Pike (Ed.), Technology Leader or Leading Technology. *The CAP [Canadian Association of Principals] Journal: The Canadian Resource for School Based Leadership*, 43–45.
- Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York, NY: Random House.
- Edwards, A. (2007). Relational agency in professional practice: A CHAT analysis. *Actio: An International Journal of Human Activity Theory*, 1, 1–17.
- Engeström, Y. (1987). *Learning by expanding: An activity theoretical approach to developmental research*. Helsinki, Finland: Orienta Konsultit.
- Fullan, M. (2011). Learning is the work. Retrieved from michaelfullan.ca/wp-content/uploads/2016/06/13396087260.pdf
- Holzman, L. (2006). Lev Vygotsky and the new performative psychology: Implications for business and organizations. In D. M. Hosking and S. McNamee (Eds.), *The social construction of organization*. Oslo: Liber.
- Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology: Research and Development*, 47(1), 61–79. doi: 10.1007/BF02299477

- Kennedy, M. M. (2016). How does professional development improve teaching? *Review of Educational Research*, 86(4), 945–980. doi: 10.3102/0034654315626800
- Lieberman, N., Ben-David Kolikant, Y., & Beerli, C. (2012). “Regressed experts” as a new state in teachers’ professional development: Lessons from computer science teachers’ adjustments to substantial changes in the curriculum. *Computer Science Education*, 22(3), 257–283. doi: 10.1080/08993408.2012.721663
- Literacy and Numeracy Secretariat. (2010). *Collaborative teacher inquiry*. Secretariat Special Edition #16. Capacity Building Series. Retrieved from http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/CBS_Collaborative_Teacher_Inquiry.pdf
- Maciel, T. (2015). Smartphones in the classroom help students see inside the black box. *APS News*, 24(3), 5–6.
- Martinovic, D., Freiman, V., & Karadag, Z. (2013). Visual mathematics and cyberlearning in view of affordance and activity theories. In D. Martinovic, V. Freiman, & Z. Karadag (Eds.), *Visual mathematics and cyberlearning: Mathematics education in the digital era* (Vol. 1, pp. 209–238). Dordrecht, Holland: Springer.
- Martinovic, D., & Manizade, A.G. (2014). Technology as a partner in geometry classrooms. *The Electronic Journal of Mathematics and Technology*, 8(2), 69–87.
- Martinovic, D., & Zhang, Z. (2012). Situating ICT in the teacher education program: Overcoming challenges, fulfilling expectations. *Teachers and Teacher Education*, 28(3), 461–469. doi: 10.1016/j.tate.2011.12.001
- Milner-Bolotin, M. (2015, May). *Making online graduate teacher education courses matter - from theory to successful technology-enhanced practice*. Paper presented at the 18th UBC Investigating Our Practices Conference, Vancouver, BC.
- Milner-Bolotin, M. (2016). Promoting deliberate pedagogical thinking with technology in physics teacher education: A teacher-educator’s journey. In T. G. Ryan & K. A. McLeod (Eds.), *The physics educator: Tacit praxes and untold stories* (pp. 112–141). Champaign, IL: Common Ground and The Learner.
- Milner-Bolotin, M. (2017). Technology-supported inquiry in STEM teacher education: Collaboration, challenges and possibilities. In I. Levin & D. Tsybulsky (Eds.), *Digital tools and solutions for inquiry-based STEM learning* (Vol. 1, pp. 252–281). Hershey, PA: IGI Global.
- Milner-Bolotin, M. (2019). Technology as a catalyst for 21st century STEM teacher education. In S. Yu, J. Mason, & H. M. Niemi (Eds.), *Shaping future schools with digital technology: An international handbook* (pp. 179–199). Switzerland: Springer.
- Milner-Bolotin, M., Fisher, H., & MacDonald, A. (2013). Modeling active engagement pedagogy through classroom response systems in a physics teacher education course. *LUMAT: International Journal on Math, Science and Technology Education*, 1(5), 523–542.

- Milner-Bolotin, M., & Moll, R. F. (2008). Physics exam problems reconsidered: Using Logger Pro technology to evaluate student understanding of physics. *The Physics Teacher*, 46(8), 494–500. doi: 10.1119/1.2999067
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
- Niemelä, M. A., & Tirri, K. (2018). Teachers' knowledge of curriculum integration: A current challenge for Finnish subject teachers. In Y. Weinberger & Z. Libman (Eds.), *Contemporary pedagogies in teacher education and development*. InTechOpen. Retrieved from <https://www.intechopen.com/books/contemporary-pedagogies-in-teacher-education-and-development/teachers-knowledge-of-curriculum-integration-a-current-challenge-for-finnish-subject-teachers>
- OECD. (n.d.). *OECD Future of education and skills 2030*. Retrieved from <https://www.oecd.org/education/2030-project/>
- OECD. (2016a). *PISA 2015 results in focus*. Paris: OECD Publishing.
- OECD. (2016b). *PISA 2015 Results: Excellence and equity in education* (Vol. I). Paris, France: OECD Publishing.
- Ontario Ministry of Education. (2014). *Achieving excellence: A renewed vision for education in Ontario*. Retrieved from <http://www.edu.gov.on.ca/eng/about/renewedVision.pdf>
- Ontario Ministry of Education. (2016). *Ontario's renewed mathematics strategy*. Retrieved from http://www.edu.gov.on.ca/eng/policyfunding/memos/april2016/dm_math_strategy.pdf.
- Opfer, V. D., & Pedder, D. (2011). Conceptualizing teacher professional learning. *Review of Educational Research*, 81(3), 376–407. doi: 10.3102/0034654311413609.
- Partnership for 21st Century Skills. (2006). *Are they really ready to work?* Retrieved from http://www.p21.org/storage/documents/FINAL_REPORT_PDF09-29-06.pdf
- Phillips, V. (2014). *Teachers know best: Teachers' views on professional development*. Bill & Melinda Gates Foundation. Retrieved from <https://k12education.gatesfoundation.org/download/?Num=2336&filename=Gates-PDMarketResearch-Dec5.pdf>
- Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, 29(1), 4–15. doi: 10.3102/0013189X029001004
- Russell, D. L., & Schneiderheinze, A. (2005). Understanding innovation in education using activity theory. *Educational Technology & Society*, 8(1), 38–53.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.
- Smylie, M. (2014). Teacher evaluation and the problem of professional development. *Mid-Western Educational Researcher*, 26(2), 97–111.

- Trust, T., Krutka, D. G., & Carpenter, J. P. (2016). "Together we are better": Professional learning networks for teachers. *Computers & Education*, 102, 15–34. doi: 10.1016/j.compedu.2016.06.007
- UBC Faculty of Education. (2019). *MEd in Science Education Program*. Retrieved from http://pdce.educ.ubc.ca/med_science/
- Van der Zalm, A. (2010). *Enhancing the involvement of parents in the mathematics education of their elementary school children* (Unpublished doctoral dissertation). Simon Fraser University, Vancouver, Canada. Retrieved from <http://www.peterliljedahl.com/wp-content/uploads/Thesis-Adrienne-Van-der-Zalm.pdf>
- Verenikina, I. M. (2003). Vygotsky's socio-cultural theory and the zone of proximal development. In H. M. Hasan, I. M. Verenikina, & E. L. Gould (Eds.), *Expanding the horizon. information systems and activity theory* (pp. 4–14). Wollongong: University of Wollongong Press. Retrieved from <http://ro.uow.edu.au/sspapers/3201>
- Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Wei, R. C., Darling-Hammond, L., & Adamson, F. (2010). Professional development in the United States: Trends and challenges (Vol. 28). Dallas, TX: National Staff Development Council. Retrieved from <https://learningforward.org/docs/default-source/pdf/nsdcstudytechnicalreport2010.pdf?sfvrsn=0>
- Westera, W. (2005). Beyond functionality and technocracy: Creating human involvement with educational technology. *Educational Technology & Society*, 8(1), 28–37.
- Winthrop, R., McGivney, E., Williams, T. P., & Shankar, P. (2016). *Innovation and technology to accelerate progress in education*. The Center for Universal Education at the Brookings Institution Retrieved from https://www.brookings.edu/wp-content/uploads/2017/02/global_20170223_innovation-and-technology.pdf

Authors

Dragana Martinovic is a professor of mathematics education at University of Windsor and a Fellow of the Fields Institute for Research in Mathematical Sciences. In her research Dragana explores ways in which technology can improve teaching and learning outcomes.

Yifat Ben-David Kolikant is an associate professor in the Seymour Fox School of Education, Hebrew University of Jerusalem. Her academic work is devoted to theorizing learning, teaching, and schooling in the age of globalization and digitalism.

Marina Milner-Bolotin is an associate professor of science education in the Faculty of Education at the University of British Columbia. She studies how technology can be used to support pre-service and in-service mathematics and science teachers who are able to engage 21st century students in meaningful learning.

ENACTING THE EDUCATIONAL WORLD IN COMPASSION: A REFLECTION AND POSITIONING OF HOW TO TEACH AND LEARN THE ART OF COMPASSION

Augustine Parattukudi
Lakehead University, Canada

Abstract: *This reflective position paper explores teaching and learning of compassion in educational institutions following the theory of enaction proposed by Varela, Thompson, and Rosch (2016). In the enactive view, information processing and cognition are situated in the dynamic relationship between the embodied organism and its environment. Following such a theoretical premise, the paper reviews the stories of two compassionate educators to propose that they enact their teaching space, indirectly transforming it into a learning space of universal compassion. A new model of teaching and learning of compassion, namely, the enactive modelling through non-egocentric responsiveness-embedded stories is suggested through the paper. The study utilizes the multimodal discourse analysis methodology for the investigation of the proposed model.*

Keywords: compassion, *enaction*, groundlessness, enactive compassion

Introduction

The Latin word for compassion, *compassio* comes from two root words, namely *com*, meaning “with,” and *pati* meaning “suffer” (Barad, 2007 p. 12). Together these words will mean “to suffer with”. The words—empathy, caring, sympathy—are related to the word compassion, but what keeps the word compassion unique is “its intrinsic motion-generated effect” (Schantz, 2007, p. 51), which compels a person to act to alleviate suffering. Goetz, Keltner, and Simon-Thomas (2010) defined compassion “as the feeling that arises in witnessing another's suffering, and that motivates a subsequent desire to help” (p. 351). A similar definition is in Nussbaum (2001), who has an elaborate explication of compassion following the Aristotelian tradition of pity. Lilius, Worline, Dutton, Kanov, and Maitlis (2011) defined “compassion capability as the reliable capacity of members of a collective to notice, feel, and respond to suffering” (p.

874). Darwin viewed compassion as the “strongest of human's evolved instincts” (as cited in Goetz et al., 2010, p. 354). In the earliest Buddhist tradition, the Sanskrit word *anukampa* (comes from the prefix *anu* [alongside] and *kamp* [to tremble]) stood for compassion (Shogo, 2015), and the subsequent Buddhist traditions replaced it with the word *karuna* [both in Pali and in Sanskrit] (Kristeller & Johnson, 2005).

The Western philosophical exploration of compassion has been formulated in a dualistic worldview of the self and the other and is considered a self-centred emotion (Carr, 1999; Parattukudi & Melville, 2019). When appraisal of another by the compassionate subject is the basis for compassion, it can be biased, ill-informed, and influenced by the environment or presentation of the object. Such compassion can be narrow or wide according to the preference of the compassionate subject. When compassion depends on the presenting

picture of the individual object, it causes grades of compassion and fading of compassion (Västfjäll, Slovic, Mayorga, & Peters, 2014) from a friend to foe and neighbor to the stranger. Compassion conceived in this manner may provoke us to agree with the critiques of compassion for whom it is not a reliable moral construct and not good for teaching and learning (Batson, Klein, Highberger, & Shaw, 1995; Verducci, 2000). However, from a wider Buddhist understanding of *karuna* (Sanskrit word for compassion), compassion is both unlimited and universal. Considering that as non-self, living beings do not have substantial permanent selves but rather are impermanent products of conditions. Thus, all beings are suffering and that is the interdependent ground of compassion/*karuna* (Analayo, 2015; Makransky, 2012). The individual appraisal will not affect the quality of *karuna* as *karuna* is a product arising out of the awareness of the nature of suffering. Hrinco (2017) stated that in Aristotelian view of pity, “one’s circle of moral regard” (p. 34) is just limited to a small group. However, the Buddhist understanding expands to every living creature. Kupperman (1995) observed that the “limited altruism” of the West has deep roots to its philosophical construct of “individualized self” (p. 131) and in contrast Buddhism insists that the relationships (the five aggregates—*Khandas*) which makes the perception of individual self (person) is something that one must escape from to attain *nirvana* (liberation). Schopenhauer (2005), who was influenced by the Eastern philosophy, considered that the Western dualistic understanding is not helpful in compassion. According to him compassion overcomes the separation between self and the other and helps one to perceive the other as oneself. Against this background, the non-self-based compassion may be considered a universalized emotion, as Mirguet (2017) puts it, and this notion of compassion can be

confidently introduced in education and research.

Buddhist tradition considers compassion both as Buddha’s nature and as something that can be cultivated through meditation (Analayo, 2015). With the emergence of Mahayana Buddhism, compassion came to the center stage as a trainable experience. Neuroscientific researches have shown that compassion can be cultivated through training and has had positive physiological effects (Engström & Söderfeldt, 2010; Klimecki, Leiberg, Lamm, & Singer, 2013; Klimecki, Leiberg, Ricard, & Singer, 2014; Lutz, Brefczynski-Lewis, Johnstone, & Davidson, 2008; Pace et al., 2010; Weng et al., 2013). Compassion training altered altruistic behaviours and the activity in areas of neural response to suffering (Weng et al., 2013), and cognitively based compassion training reduced salivary C-reactive protein in foster care program adolescents (Pace et al., 2010). Lutz et al. (2010) indicated regulation of neural circuitry of emotion in compassion meditation by experts as compared to novices. Mongrain, Chin, and Shapira (2011) studied the effect of practicing compassion towards others for one-week period with 719 participants who were divided into a compassion group and control group. The study revealed increased happiness and decreased depressive symptoms in the compassion group. The benefits through compassion training and its effects on amygdala can be transferred to the non-meditative mental state in a person (Desbordes et al., 2012). Many such neuroscientific experiments on compassion have made use of the Buddhist meditative practices in their study. Specifically, the study conducted by Klimecki et al. (2013) found that distinct, non-overlapping brain regions are engaged during the empathic response and compassionate response. In their study, the subjects who showed

empathic response stimulated a particular area of the brain with negative affect and similarly subjects who exhibited compassionate response had brain activity in a different non overlapping area, which also represented positive affect. They also observed that training in compassion was able to override the negative affect induced by empathic distress.

My experiences as a mental health therapist crossing over to the field of education with an Eastern upbringing and Western higher education facilitated a simultaneous philosophical and pragmatist approach to the teaching and learning of compassion. My initial literature research on the phenomenon of compassion (Parattukudi & Melville, 2019) together with my clinical experience and study of compassionate presence paved way for this reflective project. This reflective positioning work incorporates clinical, pedagogical experiences, and neurological research on compassion with the latest studies on cognition as *embodied action* or *enaction* (Varela et al., 2016).

Enactivism in Teaching and Learning

Inspired by the phenomenology of the French philosopher Merleau Ponty (1908-1961), Varela et al. (2016) developed the theory of enaction using the 1980 work of Maturana and Varela on *autopoiesis* and the Buddhist idea of codependent arising as elaborated in their book. They stated that every organism maintains its internal organization through constant interaction with its environment or world through sensorimotor and metabolic requirements (Caracciolo, 2012). Colombetti and Thompson (2008) summarized

In enactive approach, the human mind is embodied in our entire organism and embedded in the world, and hence is not reducible to structures inside the head. Meaning and experience are created by,

or enacted through, the continuous reciprocal interaction of the brain, the body, and the world. (p. 14)

Begg (2013), in his attempt to introduce *enactivism* in teaching and learning, proposed that the idea of enactivism is contradictory to the traditional ways of teaching and learning and the separation between the learner and the world. For Davis, Sumara, and Kieren (1996) in the enactive process the distinction between the learners and learned are “mere conveniences” (p. 157), and they are co-emerging in the process. The teacher and the students are considered “part of their context (rather than in a context)” (p.157), and learning is an act of “bringing forth” (p. 158), which happens within the enactive process. Sumara and Davis (1997) following embodied cognition, argued that learning is “occasioned” rather than “caused” (p. 412). Accordingly, learning “co-emerge with complex webs of experience” (p. 412), and we cannot speak of a particular direct outcome of any action. Accordingly, Davis et al. (1996) said that this way of understanding of learning refutes the two assumptions regarding schooling, namely: we can pre-define the skills and attitudes that individuals need to be successful in society and the assumption that learning can be controlled to suite a particular desired outcome. Many of our learning happens at a non-conscious level as an “emergent process” (Begg, 2013, p. 89) like that in non-human beings. For them, learning is not “coming to know” (p. 84) of the learner and the learned; it aims at “co-solving and co-implicating” (p. 84).

An Enactive View of Compassion

As explained by Varela et al. (2016) in the enactive philosophy, compassion is contextualized in the circulatory movement of cognition and experience, as two

phenomenological axes of the same coin. Cognition, as the “embodied action” or “enaction” (pp. 172-180) shatters the myth of absolutism or a pre-given state of affairs through the introduction of groundlessness, which propels the enactive process. The doing away with the myth of absolutism can cause possible disillusionment and threat of another extreme position of nihilism. Therefore, it necessitates a transformative action rooted in groundlessness to perpetuate the circulatory movement and face the challenge of nihilism in existential lines. This axis of experience is taken care of by compassion as an embodiment of groundlessness in a scientific culture. They summarize the two phenomenological axes of compassion in the following statement, “If planetary thinking requires that we embody the realization of groundlessness in scientific culture, planetary building requires the embodiment of concern for the other with whom we enact a world” (Varela et al., 2016, p. 245).

The enactive view of compassion was first proposed in health care research by Halifax (2012) who argued that compassion is an emergent process, involving attentional, sensory, and cognitive faculties, which are interconnected and situated in and responsive to the living context of a human person. Halifax (2013) introduced the GRACE protocol for training nurses and health care professionals in compassion. GRACE stands for **g**athering attention, **r**ecalling attention, **a**ttuning to self/other, **c**onsidering, and **e**ngaging. Similar to several Buddhist meditative practices, Halifax (2012) placed the idea of groundlessness in the intention/insight axis as a subject and object in her model. As I understand, the prescriptive approach of GRACE is essentially a sequential learning and experiencing project, which does not seem enactive, rather gives a picture of many parts

creating the whole. Di Paolo, Rohde, and De Jaegher (2010) also hold a similar view that in an enactive process, many parts together does not create autonomy, rather it is the resultant identity emerging out of interactions happening in an operationally closed system.

According to Varela et al. (2016), compassion “is not derived from an axiomatic ethical system nor even from pragmatic moral injunctions. It is completely responsive to the needs of the particular situation” (p. 248). According to them, groundlessness is manifested by “non-egocentric responsiveness” (p. 252), and the process needs to engage in a training of mind in groundlessness of reality.

Beyond Teaching and Learning: Discovery of Compassion in and Through Enaction

According to Varela et al. (2016), the awareness of “groundlessness as non-egocentric responsiveness” (p. 252) guides us to connect with the other with whom “we dependently co-originate” (p. 252). In the final analysis, it appears to me that the non-egocentric responsiveness as the manifestation of groundlessness is the doorway to the learning and teaching of compassion. I would base my argument for an enactive process in compassion training on the discussion by Varela et al. (2016) that the very nature of compassion is not pre-determined but rather emerging responsive “to the particularity and immediacy of lived situations” (p. 250).

According to the proposed enactive model of compassion as graphically presented below, in the emergent and dynamic process of enactive modelling, the educators are supposed to be exemplary through the practice of modelling (Burack, Irby, Carline, Root, & Larson, 1999; Conklin, 2008) and

need to prefer real-life situation as it facilitates better emotional attunement (Hutto, Ilundain-Agurruza, & Sanchez-Garcia, 2015). Mutual participatory sense-making (Varela et al., 2016) happens between the teacher and student or students through the use of “story worlds” (Caracciolo, 2012, p. 368) with “nonegocentric responsiveness” (Varela et al., 2016, p. 252) as its content and prime motivator, which is aimed at alleviating suffering. Each story world emerges as a new story world with nonegocentric responsiveness in content and action. Nonegocentric responsiveness continues to

create content through the story world and it in turn, brings forth nonegocentric responsiveness. This continuous process of mutual participatory sense-making can involve new individuals and environments continuously evolving and emerging as autonomous systems. Learning and teaching of compassion happen simultaneously within the framework of a self-organized system of mutual participatory sense-making, which is operationally closed, meaning “whose primary effect is its own sustained production” (Di Paolo et al., 2010, p. 49).

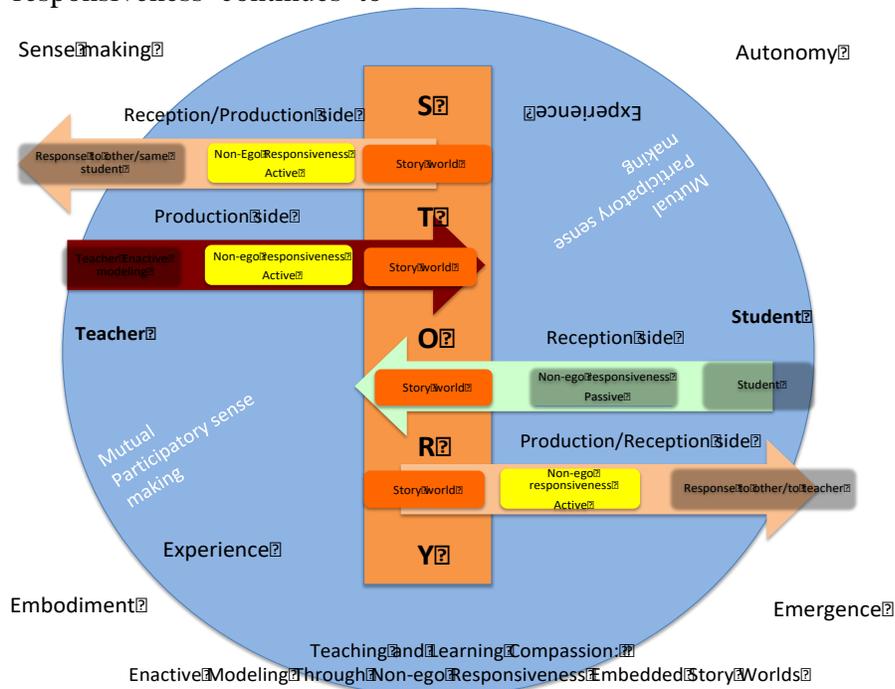


Figure 1: Graphic presentation of *enactive* compassion in teaching and learning

In the enactive view, compassion is not a single system experience but rather involves mutual participatory sense-making of multiple systems as explained by Rosch (2016). The word mutual stands for a system-based experience; participatory refers to the fact that individuals are actively participating in creating a system that is changing; and sense-making is the continuous emergence of roles, values, and meanings. Di Paolo et al.

(2010) spoke of “participatory sense-making” (p. 71) as an extension of individual sense-making in a social situation in an enactive view. According to them, this is in agreement with the five interrelated ideas of the enactive approach, namely, “autonomy, sensemaking, emergence, embodiment, and experience” (p. 37). In the above given model (Figure 1) a compassionate educator through enactive modelling (explained below) using

the non-egocentric responsiveness embedded stories (explained below) interacts with the student who enters into it from a passive non-egocentric responsiveness state. The student re-enacts and re-creates the story-world brought in by the educator, which in turn propels an active non-egocentric responsiveness in the student which has the potential to repeat a similar circle.

The following section elaborates on some of the concepts like emotional attunement, enactive modelling, use of the body, and story-world, which are useful in understanding the proposed model called the *enactive modelling through non-egocentric responsiveness embedded stories* for teaching and learning of compassion.

Emotional Attunement

Hutto et al. (2015) argued that the only way for the training of a virtue or a second nature is “to embed emotional attunement directly within the training of specific skills” (p. 1). They back this claim with a study by Oudejans (2008) involving 27 Dutch police officers in which half of the group practiced shooting at cardboard targets and half gained training by shooting each other with soap cartridges. The officers who practiced with each other showed better levels of accuracy immediately after the training and after a few months of training. They also speak about the affective learning design (ALD), which is employed in sports like using human context instead of a bowling machine aimed at the emotional attunement between the bowler and the striker in cricket. The training model is not through explicit instruction but by changing the environment like the size of the ground, the distance between players, and working on the player's mental fatigue.

Enactive Modelling

Burack et al. (1999) said that empirical evidence suggests that modelling becomes more effective when the teachers are explaining to students about what they model. According to Conklin (2008) through modelling, that is “demonstrating in action the very practices one advocates” (p. 660), the teachers need to live the pedagogy and unpack the pedagogy with students. It is for the students to know as to what is behind the teacher's practice, experience it themselves and gets to know it as their teacher experiences it. Di Paolo et al. (2010) spoke of enactive modelling of a value. The value system is understood as already included during the embryogenesis as a result of natural selection. According to them, the “value system for reaching would become active if the hand comes close to the target” (p. 52). They extended the use of this model to non-neuronal processes. Di Paolo et al. suggested the viability of enactive modelling in social interaction through a number of simulation experiments and based it on the available literature on such experiments like that of “perceptual crossing” (p. 66, a term coined by Auvray, Lenay, & Stewart, 2009), which had blindfolded human subjects as participants who interacted in a limited virtual context. According to them, these studies reveal the “importance of timing in interaction” (p. 69). Di Paolo et al. referred to the timing of the interactional coordination as “*interaction rhythm*” (p. 69, emphasis in the original), which is a necessary component of the enactive modelling process. This kind of a coordinated interaction that is emergent of the particular situation and embodiment makes the process of enactive compassion self-organized, self-sustained, and autonomous.

Use of Body

Barnacle (2009) elaborated on learning by using the body within the concept of social norms, which was introduced by Dreyfus (2006). Dreyfus explored ordinary human interactions where an individual understands how close he or she can stand in front of another individual. This kind of learning is not the same as institutionalized rules, which can be perpetuated by linguistic interventions, rather, it needs to be negotiated between two bodies and the environment. Barnacle (2009) thus promoted the need for the educational process to listen to a “sensibility of what is being learned” (p. 31) as it is experienced in the gut.

Enacting the Story World

Caracciolo (2012) said that through stories we “enact a world of significance (on the production side)-or we imaginatively enact the ‘story worlds’ generated by other human beings (on the reception side)” (p. 368). Resultant of this process is the human ability to meaning making where the recipient can experience detachment from the here and now and engage in possibilities, which may be beyond the regular habit of thinking and living. This ability is possible through the imaginative re-enactment of the story by the recipient by entering into the world of significance created by the author of the story. Any regular interaction between individuals embedded with meaning becomes a story, and the story may be expressed in language, which is a powerful tool in second-order sense-making (Froese, 2012). Language as an alternative cultural medium can control and guide enactive experiences “instead of letting the physical world ‘decide’ on what should be lived by humans” (Bottineau, 2010, p. 278). The basic intentional realm of non-egocentric responsiveness enters into the story world in

the interaction between the compassionate educator and student. The outcome of such an interaction is what we call the non-egocentric responsiveness embedded stories in the model.

Enacting the Educational World in Compassion: Exploration Using Multimodal Discourse Analysis

The model of enactive compassion (Figure 1) is further investigated through two exemplars. For this purpose, I have selected two video documentaries depicting compassionate educators, one from Arunachal Pradesh, India and the other from San Diego, California, United States. I shall explore the exemplars utilizing the multimodal discourse analysis process as elaborated in Norris (2004). Multimodal discourse analysis investigates various interlinked and interdependent interactions in communication that a person engages simultaneously beyond just speech and action. Multimodal discourse analysis considers an integral part of its analysis what is usually considered the context in conventional discourse analysis like the layout and environment. According to Norris (2004), an individual uses embodied modes like speech, gaze, gesture, and posture as well as disembodied modes like the layout of the classroom. Each mode of communication is utilized in correspondence with different degrees of awareness and attention by the communicator. When an individual uses complex, interlinked communicative modes we can speak of modal density. Modal density “refers to the intricate interplay of various modes of communication or intensity of a certain mode that a social actor employs” (Norris, 2004, p. 102). Modal density does not depend on the multiplicity of modes rather how intricate and complexly connected or intense a mode or modes are. In a focused communication some modes are present

while others are in the background. Thus Norris (2004) spoke of a “foreground-background continuum” (p. 104) in interactions. Accordingly, focused actions are happening simultaneously with higher-level actions happening in the background of the interaction. Thus, multimodal discourse analysis facilitates analysis of all identifiable communicative modes including that of the current higher-level action of an individual.

Documentary 1

Lobsang Phuntsok, born of an unwed mother, went to a Buddhist monastery and trained under Dalai Lama to become a Buddhist monk. As a monk he spent years teaching about Buddhism in the United States, then in 2006 moved to Arunachal Pradesh in India under the foothills of Himalaya and founded a residential school for children from families struggling with poverty and other similar issues. He established *Jhamtse Gatsal* (love and compassion in Tibetan), a residential community with 85 children who live and

learn in the community. The documentary *Tashi and the Monk* (Hinton & Burke, 2014) tells the story of Tashi, a five-year-old who is the youngest and newest member of the community and who tests the teachers and children with her tantrums and disturbing behaviour. The following is a short scene from the documentary depicting the powerful enactment of compassion between the teacher and the student (both the Monk and Tashi speak in the local dialect. I am narrating the story using the subtitles in English as it is seen in the documentary. The pictures are still shots from the documentary, which is available online).

The scene begins with Tashi picking a fight with another child in the room. She almost pokes a pencil into the ear of the other child. An adult teacher assistant tries to get her to the Monk’s (principal) room in spite of her tantrums and cries to not do so. Finally, she meets with the Monk, Lobsang Phuntsok, in his small office.

| Time | Transcription | Tashi | Monk | Story world | Modal density | Screen shot | |
|------|---------------|--|---|---|--|--|---|
| 5.15 | 5.16 | M. Did someone beat you? Look at me, did some one hit you? | Eyes closed, crying/weeping, head down, hand covers face | Sits at same level as T, looks at her bending forward, tries to remove her hand from covering face and establish eye contact, trying to lift her face | M. invites T to the story of the presence of a caring person | T. Low (posture, speech, gesture) M. High (gaze, posture, gesture, speech, proxemics) |  |
| | 5.28 | Don't you want to talk to me? You have to stay here until you stop crying | Keep weeping, wiping tears with her hands | Trying to listen her bending ears to her face, leaves the room for a little while | M. Invites T. to the story of the presence of one who cares but emotionally regulated/detached | T. Low (gesture, speech) M. Medium (gesture, speech, posture, layout) | |
| 5.42 | 5.52 | Have you calmed down | T alone in the room not crying, looking at the window Looks at the door, sobs a bit and goes close to M | Opens the door and comes in, sits down. M extends his hands in embrace | T. participates in M.'s story world by ability to calm down/regulate, reach out to the caring one | T. high (layout, gaze, speech, posture, gesture) M. High (layout, gesture, posture, speech, gaze) |  |
| 5.56 | 5.58 | Did you beat Maling? Did you spit on him? Have you done something wrong? What did your teacher tell you? | Her eyes are open, looks at M's heart area, She nods her head sideways in disagreement, she weeps and repeats side way node | His eyes are focused on to her face | M. invites T. to the story of the presence of a person who is the truth seeker/the judge | T. medium (gaze, gesture, speech) M. low (speech, gaze) |  |
| | 6.08 | Give me your hand. You have a wound on your finger. How did you get it? | She keeps weeping | He holds her hand in his left hand and touches the wounded finger with his right hand. He looks at the wounded finger holding her hand. | M. Invites T. again to the story of the presence of a person who deeply cares, seeing suffering, wanting to alleviate it | T. Low (speech, posture) M. high (gesture, posture, gaze, speech, layout) | |
| 6.15 | 6.15 | Does it hurt? Did you get some ointment? Is it painful? | T is not weeping as before | He touches and inspects her wound | M. invites T. to the story of the presence of someone who nurses the other | T. low (posture) M. high (speech, gesture, posture, proxemics) |  |

| Time | Transcription | Tashi | Monk | Story world | Modal density | Screen shot | |
|------|---------------|--|---|---|--|--|---|
| 6.20 | 6.24 | Look, I have one too. | She looks at M's finger | His head downward to T, inspecting the wound, total focus on her hand He looks at his hand, finds a wound on his finger and shows it to her | M. invites T. to the story of someone who is wounded and need care T. participates in the story by looking at his wounded finger. | T. low (gaze, posture) M. high (speech, posture, gaze, gesture, proxemics) |  |
| | 6.32 | Mine hurts, does yours? | She looks at M's finger | He takes her right hand and holding it, he shows his wounded finger, then signals to her wounded finger, touches it | M. invites T. to the story of fellow travellers who share their sufferings to each other. | T. Low (gaze, posture) M. high (speech, gaze, posture, gesture, proxemics) | |
| 6.34 | | | She looks at her finger and nodes up and down in agreement. | | T. responds to it by entering into the story world of the one who needs care by acknowledging her pain. | T. medium (gaze, gesture, posture) M. | |
| 6.36 | 6.37 | Are you happy here? | T nodes her head up down in agreement | Holding her right hand with both his hands, he gestures his right hand in re-assurance, looks at her eyes | M. invites T. to the story of a child who is happy T. responds to it by agreement | T. medium (gesture, posture) M. high (speech, gesture, gaze, proxemics) |  |
| | 6.41 | Nobody beats you here. | T nodes her head sideways | He asks her something (not in transcript) | M. invites T. to the story of a child who is safe | T. medium (posture, gesture, gaze) M. medium (speech, gesture, gaze) | |
| 6.44 | 6.47 | M. What should you do in class? T. Study M. That is right, study. | T looks down For the first time T speaks out. | He holds her close to him by her shoulders and looks at her face | M. invites T. to the story of a child who is motivated to study. She participates in the story world by speaking out the answer | T. medium (gaze, speech) M. high (speech, proxemics, gaze, gesture) |  |
| 6.50 | 6.51 | Sometime being naughty is ok. But the rest of the time you have to study and listen to | T looks into to M's eyes (first time) She keeps the gaze stable and nodes her head up and down a few times in agreement. | He holds her by the lower armpit and looks at her. He gestures (growing up) with his hands as he speaks. He again holds her on her shoulders. | M. invites to the story of a child who is fun loving yet responsible and respectful | T. high (gaze, gesture, posture, new gesture) M. high (speech, gesture, posture, proxemics) |  |

| Time | Transcription | Tashi | Monk | Story world | Modal density | Screen shot | |
|-------|---------------|--|---|---|---|---|---|
| | | your elders. When you grow up like me you will be very happy. | Her hands are busy playing with her clothes' ebbs. | | | | |
| 7.05 | 7.06 | Now you have to stop crying and smile. | Her head is initially down but lifts to look at him, she looks away for a few moments, looks around and looks out | He places both his hands on her cheeks (affection) He gestures like wiping her tears and removes his hand. | M. invites T. to the story a child who is regulated and happy | T. medium (gaze, gesture, posture, layout) M. high (speech, gesture, posture, proxemics) |  |
| | 7.12 | M. Shall I walk you to your class? T. Yes | She looks at him, nods her head in agreement, says "yes" | He once again places his hand on her cheek. And holds her hand to take her to classroom | M. invites T. to the story of the presence of someone who respects her and ready to go an extra mile with her | T. high (gaze, gesture, speech, posture) M. medium (speech, gesture, posture) | |
| | 7.23 | M. (at the door) where are your shoes? ...You don't have any shoes? | Her hand is his hand and she follows him | He holds her by hand and walks with her. He opens the door and takes her out of the room. The room is closed | M. invites T. to the story of the presence of someone who notices her suffering and wants to alleviate it | T. low (gesture, layout) M. high (speech, gesture, posture, proxemics) | |
| 46.50 | 47.15 | M. You like fighting or you like to be friends? T. I like to be friends | T is excited, smiles, looks at his face | M bending forward, engaging his hands gesturing fight and friendship. He nods in agreement at her answer | M. invites T. to the story of a child stopping fights and building friendships T. responds to the story by participating in it by expressing desire to be a friend | T. high (speech, gesture, posture, proxemics, layout) M. high (speech, gesture, posture, proxemics, layout) |  |
| 47.44 | 47.49 | M. What should you teach them? T. First eat your food, go to your class, don't fight with each other, listen to your elders, | T sitting very close to him with other two kids, she rocks herself with him and looking at his face answers his questions counting in her hand And then stands up and sticks a sticker on his forehead. | He sits with T and other two kids in the open ground, distributing stickers to them. He holds her close to him, rocks with her, looks at her eyes, listens and responds to her answers. | M. invites T. to the story of a good older sister to other troubled children. T. participates in the story world by agreeing to live as an older sister teaching and supporting younger kids. | T. high (speech, gesture, gaze, proxemics, body movement, layout) M. high (speech, proxemics, gesture, posture, body movement, layout) |  |

In the above given exemplar, the non-egocentric responsiveness of the Monk rooted in an enactive modelling process (the right response at the right time), holds the hand of Tashi (emotional attunement), and emerges into a story world (the story of the

Monk and the story of Tashi emerges into a new story). We can see how the little girl is getting consoled and does not feel the need to defend her point. The Monk continues to emerge into another enactment of non-egocentric responsiveness with the new story

world through the question: shall I walk you to the classroom? and the subsequent noticing and inquiry about Tashi’s footwear. The last part of the documentary as explained in the above tabulation (time 46.50-47. 49) shows how Tashi responds spontaneously to a situation with non-egocentric responsiveness as explained in the enactive compassion model (Figure 1).

Documentary 2

Godwin Higa was the principal of Cherokee Point Elementary School in San Diego, California. The school is located in an area consisting of only 1.5% of the geographical area of San Diego, but has a reported violent crime rate of 15 %, total murder rate of 25 %, and had the highest domestic violence in the city of San Diego. Cherokee Point Elementary School became the first trauma-

informed school in San Diego under the compassionate leadership of Mr. Higa. In a 2015 short documentary titled *Creating a Culture of Compassion in Schools*, (Andrews, 2015), Mr. Higa in his monthly chat with students and staff says, “So, when students come to school, and they are not feeling well, or they are acting out, it is not about going to Mr. Higa, it is about what is happening with you? What can I do to help you? We lead with compassion”.

Below given is a short scene from the video showing two children in his office who have been fighting over something. The young girl is complaining about the young boy. Principal Higa intervenes. (The pictures are still shots from the documentary which is available online).

| Time | Transcription | Higa | students | Story world | Modal density | Screen shot | |
|------|---------------|--|--|---|---|--|---|
| 7.30 | 7.31 | I thought..., you guys are friends? , Ok... You will have to... friends don't fight. Friends are nice to each other, isn't it? | He sits on a chair, looking at the student s, gesturing with his hands | The boy responds to Higa, “yea Ok”, looking at him, gesturing Standing near to the boy is the girl who is looking at Higa and wiping off tears from her face. She also nods her head in agreement | Mr. Higa invites the students to a story world of friends who are nice to each other. The question, challenges the children to explore a world where they don't need to fight | Higa. High (gaze, gesture, speech, layout, posture) Students. High (gaze, posture, gesture, proxemics, layout) |  |
| 7.46 | 7.46 | | He listens to them, as the boy is talking | The boy turns to the girl and give a hug She receives the hug and wipes off teas from her face | Encouraged by the story world of friends being nice to each other, the children enact a compassionate gesture of accepting each other | Higa. Medium (gaze, posture, gesture) Children. High (speech, posture, gesture, proxemics, layout) |  |

The children, after having some more conversation, finally embrace each other to show that they are no longer fighting but ready to support and show compassion to

each other. Here again, the non-egocentric responsiveness inspires Principal Higa to ask a creative and challenging question to the children who were fighting, namely, whether

they were friends? Further, he becomes instrumental in evoking a story world where everyone is participating through the statement that friends do not fight. The story world guides the children to respond in non-egocentric responsiveness, which is manifested in their mutual hug and re-establishing friendship.

Conclusion

Varela et al. (2016) think that any learning process that facilitates the letting go of the ego-centred behaviour pattern is helping spontaneous compassion to be self-sustaining. Both the above-given exemplars show how the non-egocentric responsiveness is intertwined with a story world of the same content that furthers the movement of compassion in both the educator and the student. There is no blame or defence but enacting of non-egocentric content as and when determined by the autonomous emergence in the context, which has the potential to be operationally closed, repeatedly producing non-egocentric responsiveness. In both the exemplars, the compassionate educator and students are

charged with non-egocentric responsiveness, which is potential for the emergence of further enactments of non-egocentric responsiveness embedded stories and thus, the operationally closed process can continue self-sustained. The proposed enactive modelling through non-egocentric responsiveness embedded stories is aimed at creating an organic, sustainable, and pedagogically self-sufficient process to the teaching and learning of compassion. Compassionate educators can intentionally be oriented towards this spontaneously occurring method or process of enactive modelling in their efforts to be more grounded in groundlessness in a scientific culture. This investigation continues to affirm the idea that compassionate educators enact their teaching space, indirectly transforming it into a learning space of compassion. While some of the educators may have already been practicing compassion in teaching and learning just as the compassionate educators in this paper, others may benefit from a model like as they can use it in their own pedagogical reflection and practice.

References

- Analayo, B. (2015). *Compassion and emptiness in Buddhist meditation*. Cambridge: Windhorse.
- Andrews, A. S. (2015). *Creating a culture of compassion in schools* [15min]. Retrieved from <https://www.acesconnection.com/g/Parenting-with-ACEs/clip/creating-a-culture-of-compassion-in-schools-15min>
- Auvray, M., Lenay, C., & Stewart, J. (2009). Perceptual interactions in a minimalist virtual environment. *New Ideas in Psychology*, 27(1), 32–47. doi: 10.1016/j.newideapsych.2007.12.002
- Barad, J. A. (2007). The understanding and experience of compassion: Aquinas and the Dalai Lama. *Buddhist-Christian Studies*, 27(1), 11–29.
- Barnacle, R. (2009). Gut instinct: The body and learning. *Educational Philosophy and Theory*, 41(1), 22–33. doi: 10.1111/j.1469-5812.2008.00473.x
- Batson, C. D., Klein, T. R., Highberger, L., & Shaw, L. L. (1995). Immorality from empathy-induced altruism: When compassion and justice conflict. *Journal of Personality and Social Psychology*, 68(6), 1042–1054. doi: 10.1037/0022-3514.68.6.1042

- Begg, A. (2013). Interpreting enactivism for learning and teaching. *Education Sciences & Society*, 4(1), 81-96.
- Bottineau, D. (2010). Language and enaction. In J. Stewart, O. Gapenne, & E. Di Paolo (Eds.), *Enaction: Towards a new paradigm for cognitive science* (pp. 267-306). Cambridge, MA: MIT Press.
- Burack, J. H., Irby, D. M., Carline, J. D., Root, R. K., & Larson, E. B. (1999). Teaching compassion and respect. *Journal of General Internal Medicine*, 14(1), 49–55. doi: 10.1046/j.1525-1497.1999.00280.x
- Carr, B. (1999). Pity and compassion as social virtues. *Philosophy*, 74(3), 411–429. doi: 10.1017/S0031819199000479
- Caracciolo, M. (2012). Narrative, meaning, interpretation: An enactivist approach. *Phenomenology and the Cognitive Sciences*, 11(3), 367–384. doi: 10.1007/s11097-011-9216-0
- Colombetti, G., & Thompson, E. (2008). The feeling body: Towards an enactive approach to emotion. In W. F. Overton, U. Mueller, & J. Newman (Eds.), *Developmental perspectives on embodiment and consciousness* (pp. 45–68). New York: Erlbaum.
- Conklin, H. G. (2008). Modelling compassion in critical, justice-oriented teacher education. *Harvard Educational Review*, 78(4), 652–674. doi: 10.17763/haer.78.4.j80j17683q870564
- Davis, A. B., Sumara, D. J., & Kieren, T. E. (1996). Cognition, co-emergence, curriculum. *Journal of Curriculum Studies*, 28(2), 151–169. doi: 10.1080/0022027980280203
- Desbordes, G., Negi, L. T., Pace, T. W. W., Wallace, B. A., Raison, C. L., & Schwartz, E. L. (2012). Effects of mindful-attention and compassion meditation training on amygdala response to emotional stimuli in an ordinary, non-meditative state. *Frontiers in Human Neuroscience*, 6, 1–15. doi: 10.3389/fnhum.2012.00292
- Di Paolo, E. A., Rohde, M., & De Jaegher, H. (2010). Horizons for the enactive mind: Values, social interaction, and play. In J. Stewart, O. Gapenne, & E. A. Di Paolo (Eds.), *Enaction* (pp. 32–87). Cambridge, MA: The MIT Press
- Dreyfus, H. L. (2006). Overcoming the myth of the mental. *Topoi*, 25(1), 43–49. doi: 10.1007/s11245-006-0006-1
- Engström, M., & Söderfeldt, B. (2010). Brain activation during compassion meditation: A case study. *The Journal of Alternative and Complementary Medicine*, 16(5), 597–599. doi: 10.1089=acm.2009.0309
- Froese, T. (2012). From adaptive behaviour to human cognition: A review of enaction. *Adaptive Behavior*, 20(3), 209–221. doi: 10.1177/1059712311433892
- Goetz, J. L., Keltner, D., & Simon-Thomas, E. (2010). Compassion: An evolutionary analysis and empirical review. *Psychological Bulletin*, 136(3), 351–374. doi: 10.1037/a0018807
- Halifax, J. (2012). A heuristic model of enactive compassion. *Current Opinion in Supportive and Palliative Care*, 6(2), 228–235. doi: 10.1097/SPC.0b013e3283530fbc
- Halifax, J. (2013). G.R.A.C.E. for nurses: Cultivating compassion in nurse/patient interactions. *Journal of Nursing Education and Practice*, 4(1), 121–128. doi: 10.5430/jnep.v4n1p121
- Hinton, A., & Burke, J. (2014). *Tashi and the Monk / A Documentary Film*. Retrieved from <http://tashiandthemonk.com/>
- Hrinco, V. (2017). *Expansive empathy: Normative and descriptive considerations for the cultivation of empathy* (Unpublished doctoral thesis). University of British Columbia, Vancouver.

- Hutto, D. D., Ilundain-Agurruza, J., & Sanchez-Garcia, R. (2015). *Cultivating embodied virtues: Radical enactivism meets East Asian Philosophy*. Retrieved from <http://rgdoi.net/10.13140/RG.2.1.4721.0724>
- Klimecki, O. M., Leiberg, S., Lamm, C., & Singer, T. (2013). Functional neural plasticity and associated changes in positive affect after compassion training. *Cerebral Cortex*, *23*(7), 1552–1561. doi: 10.1093/cercor/bhs142
- Klimecki, O. M., Leiberg, S., Ricard, M., & Singer, T. (2014). Differential pattern of functional brain plasticity after compassion and empathy training. *Social Cognitive and Affective Neuroscience*, *9*(6), 873–879. doi: 10.1093/scan/nst060
- Kristeller, J. L., & Johnson, T. (2005). Cultivating loving kindness: A two-stage model of the effects of meditation on empathy, compassion, and altruism. *Zygon—Journal of Religion & Science*, *40*(2), 391–408. doi: 10.1111/j.1467-9744.2005.00671.x
- Kupperman, J. J. (1995). The emotions of altruism, East and West. In J. Marks, R. T. Ames, & R. C. Solomon (Eds.), *Emotions in Asian thought: A dialogue in comparative philosophy*, (pp. 123–139). New York: SUNY Press.
- Lilius, J. M., Worline, M. C., Dutton, J. E., Kanov, J. M., & Maitlis, S. (2011). Understanding compassion capability. *Human Relations*, *64*(7), 873–899. doi: 10.1177/00187267110396250
- Lutz, A., Brefczynski-Lewis, J., Johnstone, T., & Davidson, R. J. (2008). Regulation of the neural circuitry of emotion by compassion meditation: Effects of meditative expertise. *PLoS ONE*, *3*(3), 1–10. doi: 10.1371/journal.pone.0001897
- Makransky, J. (2012). Compassion in Buddhist psychology. In C. K. Germer, & R. D. Siegel (Eds.), *Wisdom and compassion in psychotherapy: Deepening mindfulness in clinical practice* (pp. 61–74). New York: Guildford Press.
- Maturana, H. R., & Varela, F. J. (1980). *Autopoiesis and cognition: The realization of the living*. Dordrecht, Holland: Reidel.
- Mirguet, F. (2017). *An Early History of Compassion: Emotion and Imagination in Hellenistic Judaism*. New York: Cambridge University Press.
- Mongrain, M., Chin, J. M., & Shapira, L. B. (2011). Practicing compassion increases happiness and self-esteem. *Journal of Happiness Studies*, *12*(6), 963–981. doi: 10.1007/s10902-010-9239-1
- Norris, S. (2004). Multimodal discourse analysis: A conceptual framework. In P. LeVine, & R. Scollon (Eds.), *Discourse and technology: Multimodal discourse analysis*. Washington, DC: Georgetown University Press.
- Nussbaum, M. (2001). *Upheavals of thought: The intelligence of emotions*. Cambridge: Cambridge University Press.
- Oudejans, R. R. D. (2008). Reality-based practice under pressure improves handgun-shooting performance of police officers. *Ergonomics*, *51*(3), 261–273. doi: 10.1080/00140130701577435
- Pace, T. W. W., Negi, L. T., Sivilli, T. I., Issa, M. J., Cole, S. P., Adame, D. D., & Raison, C. L. (2010). Innate immune, neuroendocrine and behavioral responses to psychosocial stress do not predict subsequent compassion meditation practice time. *Psychoneuroendocrinology*, *35*(2), 310–315. doi: 10.1016/j.psyneuen.2009.06.008
- Parattukudi, A., & Melville, W. (2019). Understanding the phenomenon: a comparative study of compassion of the West and karuna of the East. *Asian Philosophy*, *29*(1), 1–19. doi: 10.1080/09552367.2019.1584970
- Rosch, E. (2016). Introduction to the revised edition. In F. J. Varela, E. T. Thompson, & E. Rosch (Eds.), *The embodied mind: Cognitive science and human experience* (Revised edition). Cambridge, MA.: The MIT Press.

- Schantz, M. L. (2007). Compassion: a concept analysis. *Nursing Forum*, 42, 48–55. doi: 10.1111/j.1744-6198.2007.00067.x
- Schopenhauer, A. (2005). *The basis of morality* (A. B. Bullock, Trans.). Mineola, NY: Dover Publications.
- Shogo, W. (2015). Compassion (karuṇā) and pity (anukampā) in Mahayana Sutras. *Journal of International Philosophy*, (4), 267–272.
- Sumara, D. J., & Davis, B. (1997). Enactivist theory and community learning: Toward a complexified understanding of action research. *Educational Action Research*, 5(3), 403–422. doi: 10.1080/09650799700200037
- Varela, F. J., Thompson, E. T., & Rosch, E. (2016). *The embodied mind: Cognitive science and human experience* (Revised edition). Cambridge, MA: The MIT Press.
- Västfjäll, D., Slovic, P., Mayorga, M., & Peters, E. (2014). Compassion fade: Affect and charity are greatest for a single child in need. *PLoS ONE*, 9(6), 1–10. doi: 10.1371/journal.pone.0100115
- Verducci, S. (2000). A conceptual history of empathy and a question it raises for moral education. *Educational Theory*, 50(1), 63–80. doi: 10.1111/j.1741-5446.2000.00063.x
- Weng, H. Y., Fox, A. S., Shackman, A. J., Stodola, D. E., Caldwell, J. Z., Olson, M. C., ... Davidson, R. J. (2013). Compassion training alters altruism and neural responses to suffering. *Psychological Science*, 24(7), 1171–1180. doi: 10.1177/0956797612469537

Author

Augustine Parattukudi was born and brought up in India and migrated to Canada to pursue studies in psychotherapy and education. He is currently practicing as a registered psychotherapist in Canada and doing his doctoral studies in teaching and learning of compassion.

TEACHER EDUCATION IN A POST NATION STATE ERA:
A POSSIBLE ECOLOGICAL APPROACH:
A DISCUSSION AND REFLECTION

Karen Bjerg Petersen
Aarhus University, Denmark

DeeDee Mower
Weber State University, USA

Abstract: *The aim of the paper is to discuss recent trends related to tendencies in education policy and education worldwide. Neoliberal education policy as a coherent cross-national education policy set by the Organisation for Economic Co-operation and Development (OECD) standards, Program for International Student Assessment (PISA) tests, and other transnational educational comparisons influencing traditional national education policy, has been evident for many years., This tendency has been prevalent in Denmark and the United States for years as well. A range of prominent educational philosophers and educators have challenged these trends, pointing to the fact that the unintended implications have been a narrowing of curriculum to focus on teaching to the test activities and resulting in a decline in critical thinking among students. Many educators and educational philosophers have joined the critique towards recent transnational education policy. In reference to ongoing and intense discussions, the aim of this paper is to discuss and rethink new approaches. Based on revisiting educational ideas of educational thinkers such as Dewey, Klafki, and Biesta, the authors and others, attempt to develop a notion of a more balanced education system, named “the ecological approach”. An ecological approach in education and teacher education focuses on uniqueness, integrity, resilience, and personal development of students in combination with a skill-focused training of the student as a whole person.*

Keywords: neoliberalism, neoconservative, education, ecological approach, curriculum, educational theory

Introduction

Recent decades of education policy worldwide have witnessed a transformation in the understanding of education from welfare state concepts towards competition state concepts, in which neoliberal education policy is a cornerstone (Ball, 2006, 2015; Cerny, 2007). Neoliberal education policy as a cross-national education policy, partly set by the Organisation for Economic Co-operation and Development (OECD), the Programme for International Student’s Assessment (PISA) testing programme, Trends in International Mathematics and Science Study (TIMSS), the Progress in

International Reading Literacy Study (PIRLS), and other transnational educational comparison programs, has influenced nations’ education policy worldwide and has furthermore, been evident for many years (OECD, 2018; PISA, 2018; TIMSS & PIRLS, 2018). A range of prominent educational philosophers and educators have challenged these trends and joined the critique towards recent transnational education policy (Apple, 2006; Ball, 2006, 2015, 2015a; Berliner, 2009; Berliner & Glass, 2014; Biesta, 2007, 2010; Connell, 2013; Kapoor, 2011; McGregor, 2009; Nordenbo, 2008). In reference to the ongoing and intense debate worldwide—a debate that

has been prevalent in Denmark as well as the United States (Foucault, 1977, Nordenbo, 2008; Rahbek Schou, 2006, 2010)—the aim of this article is to set out to discuss and rethink experienced and new approaches to education policy and teacher education based on an introduction to neoliberal education policy, and some of the critique raised. We will introduce some of the educational thinkers and philosophers who have challenged the trends and set out to develop a more balanced education system. These theories and reflections lead to an introduction of an ‘ecological approach’ in teacher education and education policy.

Neoliberal Education Policy

Originally, the concept of neoliberalism has been associated to mostly economic policy focusing on privatization, free trade, and marketization in order to increase the role of the private sector in economy and society (Ball, 2006). In the 1980s and 1990s in England, neoliberalism was introduced in British education policy while Margaret Thatcher was head of the government (Ball, 2006). In the United States, the elementary and secondary education act, the so-called No Child Left Behind Act (NCLB) from 2001 (Klein, 2018)—introduced a neoliberal in American terms—described as a neoconservative education policy (Berliner & Glass, 2017; Klein, 2018; Nichols & Berliner, 2007). The NCLB Act and education reforms in the wake of a neoliberal education policy introduced standards-based education reforms, testing, and measurement that allowed the government to determine the priority of subjects to be taught, the way they might be taught, and reforms available to schools that do not perform without addressing funding inequalities that perpetuate the achievement gaps (Hirsch, 2007; Torres, 2008). It also created a space for vouchers and charter schools, which was

a logical conclusion for education to become for-profit institutions (Trammel, 2005). Worldwide the neoliberal education policy eventually has been introduced to most countries in recent decades (Connell, 2013; Kapoor, 2011; McGregor, 2009). Denmark and the Scandinavian countries, being no exceptions, witnessed the consequences of neoliberal education policy in recent decades (Nordenbo, 2008; Rahbek Schou, 2006, 2010). Internationally, the globalized comparisons among students’ performance in different countries is essential, and the PISA (2018), TIMMS & PIRLS (2018) tests expose competition at a global level regarding students’ standards and performance in various subjects. Ball (2006) stated that the changes in the understanding of the purpose of education in the neoliberal education policy discourse have been significant throughout the world.

Critical Discussions and Negative Implications of Neoliberal Education Policy

Following the rise of neoliberal/neoconservative education policy, educators and educational researchers worldwide have started to criticize, register, and eventually point out unintended and negative implications. The critique has focused on various aspects ranging from general to specific. Many researchers have criticized the fact that education globally is transformed and being understood in concepts and terminology of economy, marketization, and competitiveness (Apple 2011; Ball, 2006; Biesta, 2007; McGregor, 2009).

First critique point: Education as a market. One of the main critique points with respect to neoliberal and neoconservative education policy is that education—in contrast to former welfare-based concepts—is being conceived of as a market. The

Australian researcher McGregor (2009) emphasized that, “global capitalism has placed education at the forefront of national competitiveness, and governments have responded with education policies primarily designed to serve the needs of the market. Such neo-liberal economic imperatives have been supported by a variety of neoconservative social forces calling for schools to become sites of cultural and moral restoration” (p. 345). The American researcher Apple (2011) commented on the “processes of ‘conservative modernization’ of education and the ‘complicated alliance behind the wave after wave of educational reforms that have centered around neo-liberal commitments to the market and a supposedly weak state” (p. 21). The British educational researcher Ball (2006) described the neoliberal development and outlined that,

the market solution (...) is a new master narrative, a deeply fissured but primary discourse (...) The discourse constructs the topic and as with any discourse, it appears across a range of texts, forms of conduct and at a number of different sites at any one time. (p. 74)

According to Ball, national economic issues are tied to consumer choice in education. He emphasized five main elements in the transformation of education policy in terms of neoliberal/neoconservative thought patterns:

- improving national economics by tightening a connection between schooling, employment, productivity and trade;
- enhancing student outcomes in employment related skills and competencies;
- attaining more direct control over curriculum content and assessment;
- reducing the costs of government to education;
- increasing (...) pressure of market choice. (Ball, 2006, p. 70)

Common for the critique is that the understanding of education has changed tremendously in the transition from welfare state to the post nation era and competition state. In the welfare-state-based understanding of the purpose of education—aiming at protecting the citizen—not only the European concept of ‘Bildung’ (education as being both human development shaping a sense of humanity as well as developing intellectual skills) but also the Dewey tradition of education as democracy are cornerstones (Dewey, Hahn, Boydston & Axetell, 1975). Welfare state conceptions of education perceived of education as a “non-positional good” (Nordenbo, 2008, p. 103), primarily focusing on learners’, students’, and adult participants’ personal and individual development.

Apple (2001) predicted that when education becomes a marketable commodity values for business seem to apply so that consumers want the same values, procedures, and performance indicators that work in the business world along with standardizing what is legitimate knowledge. This commodification of education then allows, Apple (2006) continued, “dominant economic groups [to] shift the blame for the massive and unequal effects of the own misguided decisions from themselves onto the state (p. 76). Furthermore, dominant or powerful figures incorporate the agency of others into their own actions and by doing so, give “power to a new elite of specialist managers in public-service institutions” (Chouliaraki & Fairclough, 1999) such as we now see in our schools.

Second critique point: Accountability and measurement as core elements in neoliberal education policy. Other researchers criticize the fact that accountability and measurement have been introduced as essential tools of control at all

levels in schooling. The Dutch-British educational researcher, Biesta (2010) criticized how measurement and accountability have replaced critical thinking, democracy, and judgement in teaching and schooling. Apple (2011) pointed to the fact that “new managerial proposals” have installed “rigorous and reductive forms of accountability in schooling at all levels” (p. 21). Ball (2015) outlined that neoliberal education policy has led to education, teaching, and teachers to being “governed by numbers” (p. 299). According to Ball, “numbers define our worth, measure our effectiveness and, in a myriad of other ways, work to inform or construct what we are today. We are subject to numbers and numbered subjects” (p. 299). The measurement, monitoring, and numbers have taken over our personal and work lives resulting in focusing on students’ test scores and other performances. In 2015, Ball wrote, Measurement and monitoring as techniques for reflection and representation play a particular role within the contemporary relationship between truth and power and the self that we call neoliberalism. As neoliberal subjects, we are constantly incited to invest in ourselves, work on ourselves and improve ourselves – drive up our numbers, our performance, our outputs – both in our personal lives and our work lives. (p. 299)

In contrast to the welfare state focus on individual meaningful development, according to the second critique point, measurement and accountability are negative implications of a neoliberal education policy that have partly dehumanized the understanding of teaching and learning and has turned mainstream teaching, teachers, and students into numbers.

Apple (2007) suggested that with new forms of accountability, policies are created that

enhance the status in moral crusades to legitimize particular types of expertise. When competition increases for these credentials, it allows some students to have less competition from other children and re-stratify a population so that cultural capital remains in the hands of those who already possess it. The English experience seems to be the same when neoliberal reforms due to marketization failed to create curriculum that was responsive and diversified but rather “radically altered the relationship of inequality that characterized schooling” (p. 70).

Third critique point: Controlling and narrowing the curriculum and focus on testing. Another critique focuses on a further negative implication points to a tendency to controlling and narrowing the curriculum. Apple (2011) criticized “neo-conservative emphases on stronger control over curricula and values” (p. 21). The democratic deficit in neoconservative educational policy and thinking desiring “to have total control over the educational process” is a critique outlined by Biesta (Winter, 2011, p. 539).

Further critique is raised regarding the intense focus on testing, and in particular, high-stakes testing. Ball (2015) mentioned the fact that measurement, statistics, and numbers introduced in education in some countries with the US being the most evident example have been closely connected to teacher salary based on students’ performance and testing scores. According to Ball (2015),

(in) teaching, the articulation of performance and improvement in terms of student test scores is more and more widely linked to another set of numbers—money—in the form of reward—that is performance-related pay. (p. 299)

American education researchers have provided evidence of how the introduction of

high-stakes testing in combination with accountability-thinking since the 1990s, and especially after the adoption of the education act, No Child Left Behind Act, has influenced education, teacher approaches, and school politics significantly (Wright, Wright, & Heath, 2003). The researchers had the opportunity to study implications of high stakes testing for several years. Most researchers show that high-stakes testing has had many negative consequences, one of which is an extended tendency to change all teaching into teaching-to-the-test activities in favour of non-test-related subjects and topics. Furthermore, a range of other negative consequences—even cases of teachers' and schools' cheating—have been listed and documented (see e.g., Berliner & Glass, 2014; Nichols & Berliner, 2007; Rahbek Schou, 2006, 2010). The American researcher, Berliner (2009), has evidenced how testing in formal education leads to both inequality and inequity, to higher drop-out rates, and to a narrowing of curriculum content with teachers and educators focusing on merely teaching-to-the-test activities and excluding disadvantaged students (Berliner & Glass, 2014; Nichols & Berliner, 2007). In Denmark, similar critique was raised, and researchers have pointed to the fact that experienced teachers in a child-centered approach have changed their focus towards testing students (Nordenbo, 2008, 2009; Rahbek Schou, 2006, 2010).

Despite initial intentions of wanting to raise students' standards by introducing standardized curriculum and testing in the wake of the neoliberal education policy, the researchers pointed to the fact that in many cases the opposite was evidenced; teachers, schools, and students focus on teaching-to-the-test activities instead of the knowledge and creative development of pupils (Klein, 2018).

Fourth critique point: Changing teacher roles. Finally, many critical researchers and educators emphasize how teaching, teachers, and their roles in neoliberal education policy are retold in new narratives in which the reflective and independent thinking teacher is replaced by the technically competent teacher (Ball, 2006). The neoliberal discourse penetrates the field of education and is combined with demands of efficiency and introduction of control over curriculum and assessment. According to Ball (2006) and Berliner and Glass (2014), and others, this contributes to classify teachers in the discourse of market economy in which not only the individual, e.g. the teacher, the headmaster, the student, but also teaching, school, and even research is retold in an understanding of governance as a means of disciplining (Wright, 2005). Foucault (1977) knew early on that “calculated gazes” or the disciplining of the body “makes possible the operation of a relations power that sustains itself by its own mechanisms” (p. 177). In 2014, Berliner and Glass introduced a book on 50 myths about the neoconservative education policy in America highlighting a range of critical points. Ball (2015a) emphasised that, “what we found in our case study schools is both forms of policy ad-hockery, borrowing, building, re-ordering, displacing, constructing and re-constructing, and patterns of compliance and standardization” (p. 308). Ball (2015a) continued that

the enactment of policy is not always linear and rational; policy work is often a piecemeal process of “fixing” problems. However, there is a ‘feedback’ process or a process of complex iterations between policies and across policy ensembles that generate forms of institutional transformation and regeneration. (p. 308)

Despite the intentions of many individual teachers' interest in students' all-round

development as whole persons, neoliberal education policy has been evidenced to influence day-to-day teaching and teachers in subtle ways beyond their personal intentions and understanding of good education.

During the past decades, the critique has been addressed in various ways. In many countries, the education reforms eventually have been changed and adjusted. For example, in 2017, the American NCLB Act from 2001 was changed to Every Student Succeeds Act (Klein, 2018), while in European countries suggestions toward more holistic and alternative approaches were raised.

Goal of Education: Three Historical and Philosophical Perspectives

Alternative and holistic approaches are however not new in the history of education policy. Before turning to the European scene, it is worth mentioning the American educational philosopher and psychologist from the early 20th century, John Dewey.

John Dewey's Educational Philosophy: Historical Roots

It is well known that one overall theme in Dewey's work was his belief in democracy politics, education, and communication. In 1888, Dewey stated "democracy and the one, ultimate, ethical ideal of humanity are to my mind synonymous" (Dewey et al., 1975, p. 138). Linking education to democracy, equality, and humanity is at the core of Dewey's ideas about the aim of education. In 1897 furthermore, in his *Pedagogic Creed*, Dewey forwarded many of his beliefs and ideas that might remind today's teachers and teacher educators about general aims of education, schools, teaching and teachers' roles. Dewey emphasized the importance of seeing schools as supporting both the

individual psychology of a single child *and* the child's social life. In fact, Dewey put the importance of social life and social activities in the foreground of education (Dewey et al., 1975).

The aim of education according to one of Dewey's creeds is to support children's development in their own social activities. Dewey wrote, "To prepare [a child] for the future life means to give him command of himself; it means so to train him that he will have the full and ready use of all his capacities" (Dewey, 1897/1959, pp. 19–20). Dewey continued "I believe therefore, that the true center of correlation on the school subjects is not science, nor literature, nor history, nor geography, but the child's own social activities" (p. 25). Dewey's critique of his own era's understanding of the teaching profession resonate with today's educational researchers' criticism of the distinctive focus on accountability, narrowed curriculum focus, and high-stakes testing, mentioned earlier in this article. Dewey stated, "I believe, that under existing conditions far too much of the stimulus and control proceeds from the teacher, because of the neglect of the idea of the school as a form of social life" (p. 24). In continuation of this, Dewey stated his opinion about education as follows, "I believe finally, that education must be conceived as a continuing reconstruction of experience; that the process and the goal of education are one and the same thing" (Dewey, 1897/1959, p. 27).

Along with Dewey, Vygotsky (1934/1987) too, theorized that children can regulate their own behavior. Dewey's idea of education as a continuing reconstruction of experience that gives students command of themselves so that they full use of all their capacities in the future mirror an alternative to mainstream educational policy at his own time but also reminds us today that education can be

conceived of in very different ways than current world-wide neoliberal education policy. Dewey's theory of education—often called learning by doing—has been influential in Europe and Scandinavia, as well (Keiding & Wiberg, 2013; Klafki, 2001, 2013).

Wolfgang Klafki's Approach: Categorical Education as a Sum of Material and Formal Education

Klafki (2001) the German post-WW II critical educational philosopher, was inspired by Dewey in developing his educational philosophy on education. In a current perspective, the synthesizing education theory of Klafki with the somewhat unfamiliar term “categorical education” can be seen as an alternative synthesizing approach to neoliberal education concepts and the critique raised. The theories of Klafki (2001/1983) played an important role in a European, Scandinavian, and Danish pedagogical context in the 1970s and into the first decade of the 21st century (Rahbek Schou, 2013). Klafki (1983) introduced the notions of material and formal education to separate two very different education traditions in Europe. Educators advocating for a material approach in education primarily turn their attention to the object of the educational process, towards its contents, that is to curriculum, learning objectives, measurement, and knowledge demands. In contrast, advocates of the formal approach and theories primarily focus on the individual or the student as a person (Klafki, 1983, cited in Rahbek Schou, 2013, p. 317). Historically, in Scandinavia and Denmark welfare state educators since World War II have mostly tended to focus on individual development and seeing education as a way to develop democratic and critical citizens. They hence focused primarily on what Klafki terms formal education. With a range of education

reforms in the 2000s-2010s in alignment with the ideas and intentions of a neoliberal education policy, the overall focus and understanding of education in Denmark and Scandinavian countries shifted to what Klafki might have called material education theory.

Klafki (1983), however, suggested a synthesis of the two approaches in which a curriculum approach focusing on learning objectives and measurable outcomes is combined with a more holistic approach focusing on the overall personal development of students. He called this approach “categorical education”: a synthesis between a standardized, test and curriculum focused education approach, launched in neoliberal education policy, a mostly material approach combined with a more holistic approach focusing on the individual learner, a formal approach. He hoped this categorical approach might inspire educators to rethink new approaches. Klafki's ideals are held similarly in America through Rose (1995), who after spending time in classrooms throughout the United States, determined that public schooling has been advanced through a “long history of educators working both within the mainstream and outside it, challenging it through workingmen's organizations, women's groups, Black schools, appropriating the ideal often against political and economic resistance, to their own emancipatory ends (p. 413). Klafki, in his theory on categorical Bildung, suggested a synthesis of a curriculum approach with a holistic approach focusing on the individual learner.

Gert Biesta: Possibilities for Teacher Professionalism: Coming into Presence in Uniqueness

The influential European educational researcher and philosopher, Biesta, in continuation of Dewey and Klafki, developed

their ideas further. In his direct critique of neoliberal tendencies in recent education policy, Biesta (2007, 2010; Winter, 2011) promoted the idea of education and students as coming into presence in their uniqueness. Biesta has criticized the implications of a neoliberal education policy in England, Europe, and worldwide in most of his works (Biesta, 2007, 2010; Winter, 2011). His critique of a democratic deficit in contemporary education may remind us about some of the core values of education forwarded by Dewey more than 100 years ago. In his critique of the neoliberal/neoconservative discourse of accountability, Biesta (2010; Winter, 2011) promoted his ideas about possibilities for future education and teachers in concepts of coming into presence, uniqueness, and pluralism. The idea of coming into presence is what is going on in the relational dimensions of a teaching process on a daily basis. When teachers and students come into the presence of each other, it leads to “an exploration of what one might call the relational dimensions of the event of subjectivity” (Biesta in Winter, 2011, p. 538).

Biesta emphasized that the idea of coming into presence is complemented by a notion of uniqueness. He described uniqueness as the special way in which teacher and student exist together. The uniqueness of a person is important in the situations in which this specific person cannot be substituted by any other person, e.g. in the situation in which it is important that this specific person is present (Biesta 2010). Winter (2011) outlined Biesta’s two ways in which uniqueness can be articulated,

one which brings us back to identity and questions about knowledge of the subject, and one which leads us to an existential argument. In my work, I have articulated this as the distinction

between uniqueness-as-difference and uniqueness-as-irreplaceability. (p. 539)

The possibility for teacher professionalism and for the dedicated teacher is to be aware of the moments in which persons are coming into presence in their uniqueness based on a plurality. Biesta (2010; Winter, 2011) promoted concepts and an idea of a pedagogy that disturbs the control and presumably normal order in evidence based education as the only existing way to understand the purpose of education. A pedagogy that disturbs the normal order according to Biesta may be able to revitalize teaching and the professionalism of the dedicated teacher as it makes it possible to consider the uniqueness rather than standards and tests.

Philosophical Approaches Summary

Common to the three educators is that they all at different historical points have criticized the mainstream way of educating children in schools. While Dewey opposed rote learning and advocated for connecting children’s learning to activities and experience, Klafki advocated for a schooling in which skills and learning objectives-oriented focus is combined with an awareness of children’s overall personal development. Biesta, in his critique of neoliberal education policy, advocates for an even more individual centered focus, emphasizing the necessity for schooling to let every individual child—besides being able to obtain knowledge—to come to presence in his or her uniqueness.

Dewey, Klafki, and Biesta represent critical voices to mainstream education at their respective time. Common for their critique is their educational philosophical approach. They primarily discuss overall goals of education with respect to the individual child’s development, rather than focusing on specific educational approaches to teaching and learning. Common for them is also the

focus on the individual child. At the center of their thinking is the interest in how each schoolchild may develop his or her potentials without being restricted by existing regulations that result in rote learning, narrowing of the knowledge based on standardized curriculum and high stake tests.

Dewey (1916) is however the only educational philosopher of the three, who *explicitly* has addressed social and societal aspects and general aims of education with his book entitled *Democracy and education: An introduction to the philosophy of education*". Dewey discussed what societal goals education should forward and advocated for the goal of education being the promotion of democracy—democracy in the schoolchild, in schools, in society, and as an overall goal of education. Increasingly, though, students and teachers alike are seeing themselves not so much as in what they do, but in who they are or believe they are, or in other words, educators, students, and their society are structured bipolarly oppositional between the Net and the Self where “social groups and individuals become alienated from each other, and see the other as a stranger, eventually as a threat” (Castells, 2000, p. 3) and where innovations are driven by the market towards educational materials that, based on the niches created by the democratic goals, are largely products and processes driven by passion and greed. Democracy, as viewed by Dewey, has a difficult task ahead in terms of education but there seems to be an uprising social connection or concern that may help in the promotion of the democracy he had hoped for that will bridge the gap between social groups.

Ecology and the Ecological Approach to Education and Teacher Education

Dewey’s ideas of the goal of education as democracy and his ideals of education as a democratic process supporting democratic societies are still immensely important in 2020, more than 100 years after the first publication of his book. However, the world has changed tremendously since then, and we face many new concerns and challenges with respect to societal, climate, and global development. We are global citizens. According to UNESCO (2015), global citizenship is defined as

a sense of belonging to a broader community and common humanity. It emphasizes political, economic, social and cultural interdependency and interconnectedness between the local, the national, and the global. (p. 14).

The United Nations and UNESCO (2015) promoted the publication, “Global citizenship education: Topics and learning objectives,” focusing on the goal of education world-wide as for schoolchildren to being able to address global challenges in the 21st century. The aims of global education are set in continuation of the UN Global Education First Initiative emphasizing that global citizenship education...

provides the understanding, skills, and values students need to cooperate in resolving the interconnected challenges of the 21st century, including climate change, conflict, poverty, hunger, and issues of equity and sustainability. (GEFI, n.d.)

Education is a global concern and must address societal and global challenges such as climate changes, conflict, poverty, equity, and sustainability.

Since 2015, many educational researchers and philosophers have developed the idea of sustainability, global responsibility, and

global citizenship further (Myers, 2016; Sklad, Friedman, Park & Omen, 2016). Educational researchers have promoted the idea of ecology as a way to implement and rethink education globally and nationally when we consider the sustainability and the sharing of resources throughout our future social evolution and what might constitute private wealth along with social programs. There needs to be revolutionary ideas that no longer are class-based decisions.

A range of educational researchers in various disciplines have discussed and forwarded ideas about ecology as being important also for education (Gibson, 1977, 1978; van Lier, 2000, 2004, 2007, 2010). The American linguist and educational researcher, van Lier (2004), emphasized that an ecological perspective on education, teaching, and learning at its core is ontological. Our world view in the way we know how to be and how to act in relation to others, and our environment is taught to us, and we learn it within the era of time it is given. Gibson (1978) explored the ecological perspective of students' relationships to the environment or ecosystem through considering the interactions we have with living elements. Van Lier (2010) suggested that the development of our ideological and political perspectives is part of the learning process. From an ecological perspective, hence, van Lier (2010) stated

all learning is the ability to adapt to one's environment in increasingly effective and successful ways ... An ecological perspective is not neutral since it explicitly includes a non-passive relationship between the ... learner and the environment, in all the spheres of physical, social and symbolic functioning. This then adds an ethical and moral dimension to learning. (p. 97)

Thus, we can balance neoliberalism and its focus on market values with neoconstructivism's tie to traditional values.

An Ecological Approach: Implications for Teaching and Learning

In his efforts to define which implications for teaching and learning an ecological approach would have, van Lier (2010) outlined that the understanding of interconnectedness and complexity are central. He emphasized that the very social, physical, and symbolic levels of both the teachers' and students' actions and activities are complex and intertwined with interactions and language that make up the network of interdependency. According to van Lier, learners need to make choices and employ agency in more self-directed ways. Learners must be active, and "activity in a meaningful environment generates affordances for enhancing that activity and subsequent activities" (Van Lier, 2010, p. 6). Relationships, quality and agency are core values in an ecological approach. Van Lier wrote that "ecology is the study of the relationships among elements in an environment or ecosystem, in particular the interactions among such elements" (p. 5).

Furthermore, in his description of quality as a core value in education, van Lier in alignment with Apple (2006), Berliner (2009), and Biesta (2010), criticized neoliberal education policy focus on testing. Instead he advocated for shifts in the system away from testing dependency to appraisal systems that promote, address, and document educational experiences. Also, the emphasis on testing and core curriculum that limits how teachers teach about the environment and ecological impact on the students' local communities, places accountability and effort inward rather the outward. Current place-based education (PBE) proponents (Woodhouse & Knapp, 2002; Zink, 2014)

find their roots in Dewey's focus on students' experiences with subject matter.

Finally, agency is seen as the third core notion. Van Lier (2010) wrote that agency has many manifestations that is more profound than autonomy, motivation and investment since these terms only apply to the manifestation of a person's agency.

Conclusion

An ecology perspective on education sets out to reflect education as a local, national, and global societal value-based active process, which addresses global challenges. Core values in an ecological education as a general education philosophy are sustainability, resilience, and a certain robustness of education in order to face new global demands of the 21st century. The perspective introduces an ecological philosophy of education, in which education is seen as essential and central to addressing global and local challenges that arise out of the new set of ways that the world of today is organized. An ecological education calls for responsibility for sustainable development within various areas of life. As such education is responsible for developing

resilient values and systems in flexible ways, in which social systems are reflected and understood as being able for change.

An ecological perspective on educational philosophical thinking addresses global and societal aspects with respect to the interconnected challenges and core concerns of the 21st century global communities, outlined in the UN Secretary General's First Global Education Initiative (GEFI, n.d.). Similar to the global citizenship education, an ecological perspective emphasizes "political, economic, social, and cultural interdependency and interconnectedness between the local, the national, and the global" (UNESCO, 2015, p 14). At the local level, other researchers have forwarded core concepts in an ecological approach (Gibson, 1977, 1978; Myers, 2016; Sklad et al., 2016; van Lier 2004, 2010) and.

Many aspects in an ecological approach, however, still need further reflections and development. The importance of setting out new ways of conceiving of education, aims and goals of education, teaching, teacher education, and learning in post nation state seem to be relevant.

References

- Apple, M. W. (2001). Comparing neo-liberal projects and inequality in education. *Comparative Education*, 37(4), 409–423.
- Apple, M. W. (2006). *Educating the "right" way: Markets, standards, God, and inequality*. New York: Routledge.
- Apple, M. W. & Beane, J. A. (2007). *Democratic schools*. Portsmouth, NH: Heinemann.
- Apple, M. W. (2011). *Education and power*. New York, NY: Routledge.
- Ball, S. J. (2003). The teacher's soul and the terrors of performativity. *Journal of Education Policy*, 18(2), 215–228. doi: 10.1080/0268093022000043065

- Ball, S. J. (2005). *Education policy and social class: The selected works of Stephen J. Ball*. London: Routledge.
- Ball, S. J. (2012). Performativity, commodification and commitment: An I-spy guide to the neoliberal university. *British Journal of Educational Studies*, 60(1), 17–28. doi: 10.1080/00071005.2011.650940
- Ball, S. J. (2015). Education, governance and the tyranny of numbers. *Journal of Education Policy*, 30(3), 299–301. doi: 10.1080/02680939.2015.1013271
- Ball, S. J. (2015a) What is policy? 21 years later: Reflections on the possibilities of policy research. *Discourse: Studies in the Cultural Politics of Education*, 36(3), 306–313. doi: 10.1080/01596306.2015.1015279
- Berliner, D. C. (2009). The incompatibility of high-stakes testing and the development of skills for the 21st century. In R. Marzano (Ed.), *On excellence in teaching*. Bloomington, IN: Solution Tree Press.
- Berlinger, D. C., & Glass, G. V. (2014). *50 myths and lies that threaten America's public schools: The real crisis in education*. New York, NY: Teachers College Press.
- Biesta, G. J. J. (2007). Why “what works” won’t work: Evidence-based practice and the democratic deficit in educational research. *Educational Theory*, 57(1), 1–22. doi: 10.1111/j.1741-5446.2006.00241.x
- Biesta, G. J. J. (2010). *Good education in an age of measurement: Ethics, politics, democracy*. Boulder, CO: Paradigm Publishers.
- Castells, M. (2000). *The rise of the network society*. Oxford: Blackwell.
- Cerny, P. G. (2007). Paradoxes in the competition state: The dynamics of political globalization. *Government and Opposition*, 32(1), 251–274.
- Chaffee, B. W., & Weston, S. J. (2010). Association between chronic periodontal disease and obesity: A systematic review and meta-analysis. *Journal of Periodontology*, 81(12), 1708–1724. doi: 10.1902/jop.2010.100321
- Chouliaraki, L., & Fairclough, N. (1999). *Discourse in late modernity – Rethinking critical discourse analysis*. Edinburgh: Edinburgh University Press.
- Connell, R. (2013). The neoliberal cascade and education: An essay on the market agenda and its consequences. *Critical Studies in Education*, 54(2), 99–112. doi: 10.1080/17508487.2013.776990
- dewey2016.co.uk (n.d.). *John Dewey's 'Democracy and Education': 100 years on: Past, present, and future relevance*. Conference at Faculty of Education, University of Cambridge, UK.
- Dewey, J. (1897/1959). My pedagogic creed. *School Journal*, 54(1897), 77–80.
- Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education*. US: Macmillan.

- Dewey, J., Hahn, L. E., Boydston, J. A., & Axetell, G. E. (Eds.). (1975). *The early works of John Dewey, Vol. 1, 1882-98: Early essays and Leibniz's new essays, 1882-88*. Carbondale, IL: Southern Illinois University Press.
- Foucault, M. (1977). *Discipline & punish: The birth of the prison*. New York: Random House.
- GEFI (n.d.). *Global Education First Initiative. The UN's Secretary General's global initiative on education*. Retrieved from <http://www.unesco.org/new/en/gefi/home/>
- Gibson, J. J. (1977). The theory of affordances. In R. Shaw & J. Bransford, (Eds.), *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*. Hillsdale, NJ: Lawrence Erlbaum.
- Gibson, J. J. (1978). The ecological approach to the visual perception of pictures. *Leonardo*, 11(3), 227–235. Retrieved from <http://muse.jhu.edu.ez.statsbiblioteket.dk:2048/article/>
- Hirsch, D. (2007). Assessing No Child Left Behind and the rise of the neoliberal education policies. *American Educational Research Journal*, 44(3), 493–518.
- Kapoor, D. (Ed.). (2011). *Critical perspectives on neoliberal globalization, development and education in Africa and Asia*. Rotterdam, The Netherlands: Sense Publishers
- Keiding, T. B., & Wiberg, M. (2013). Handlingsorienteret didaktik/action-oriented didactics. In A. Qvortrup & M. Wiberg (Eds.), *Læringsteori og didaktik/learning theory and didactics*. Copenhagen: Hans Reitzels.
- Klafki, W. (1983). *Kategorial dannelse og kritisk-konstruktiv pædagogik: udvalgte artikler*. København: Nyt Nordisk Forlag. [Translation: Categorical bildung and critical constructive pedagogy – selected articles. Copenhagen: Nyt Nordisk Forlag]
- Klafki, W. (2001). *Dannelsesteori og didaktik: Nye studier*. [Translation: *Theories of bildung and didactics: New studies*]. Aarhus, Denmark: Klim.
- Klein, A. (2018, April 15). No Child Left Behind: An overview. *Education Week*. Retrieved from <https://www.edweek.org/ew/section/multimedia/no-child-left-behind-overview-definition-summary.html>
- McGregor, G. (2009). Educating for (whose) success? Schooling in an age of neo-liberalism. *British Journal of Sociology of Education*, 30(3), 345–358. doi: 10.1080/01425690902812620;
- Myers, J. P. (2016). Charting a democratic course for global citizenship education: Research directions and current challenges. *Education Policy Analysis Archives*, 24(55). doi: 10.14507/epaa.24.2174
- Nichols, S. N., & Berliner, D. C. (2007). *Collateral damage: The effects of high-stakes testing on America's schools*. Cambridge, MA: Harvard Education Press.
- Nordenbo, S. E. (2008). Fra progressiv til liberal pædagogik. In F. Collin og J. Faye (Eds.), *Ideer vi lever på. Humanistisk viden i videnssamfundet*. København: Akademisk Forlag.
- Nordenbo, S. E., Allerup, P., Andersen, H. L., Dolin, J., Korp, H., Larsen, M. L. ... Østergaard, S. (2009). *Pædagogisk brug af test – et systematisk review*. København, Danmarks Pædagogiske Universitetsforlag og Dansk Clearinghouse for uddannelsesforskning.

- Organisation for Economic Co-operation and Development [OECD]. (2018). About OECD. Retrieved from <http://www.oecd.org/about/>
- Programme for International Student Assessment [PISA]. (2018). *PISA*. Retrieved from https://www.oecd-ilibrary.org/education/pisa_19963777
- Rahbek Schou, L. (2006). *Standards and accountability*. Unpublished paper presented at 26th ISTE Annual Seminar in South Africa.
- Rahbek Schou, L. (2010): Danish teacher attitudes towards national student testing: A comparison between NCLB and Danish national testing standards. In D. K. Sharpes (Ed.), *Handbook on International Studies in Education*. Charlotte, NC: Information Age Pub.
- Rahbek Schou, L. (2013). Kritisk-konstruktiv pædagogik og didaktik [Translation: Critical-constructive pedagogy and didactics]. In A. Qvortrup, & M. Wiberg (Eds.), *Læringsteori og didaktik/Learning theory and didactics*. Copenhagen: Hans Reitzels Forlag.
- Rose, M. (1995). *Possible lives*. New York: Houghton Mifflin.
- Sklad, M., Friedman, J., Park, E., & Omen, B. (2016): ‘Going global’: A qualitative and quantitative analysis of global citizenship education at a Dutch liberal arts and sciences college. *Higher Education*, 72(3), 323–340. doi: 10.1007/s10734-015-9959-6
- TIMSS & PIRLS. (2018). International study center. Lynch School of Education. Boston College. Retrieved from <https://timssandpirls.bc.edu/index.html>
- Torres, C. (2008). No Child Left Behind: A brainchild of neoliberalism and American politics. *New Politics*, 10(2), 1–12.
- Trammell, L. (2005). Measuring and fixing, filling and drilling: The ExxonMobile agenda for education. In D. R. Boyles (Ed.), *Schools or markets? Commercialism, privatization, and school-business partnerships* (pp. 31–46). London: Lawrence Erlbaum.
- UNESCO. (2015). *Global citizenship education. Topics and learning objectives*. Retrieved from <http://unesdoc.unesco.org/images/0023/002329/232993e.pdf>.
- Van Lier, L. (1997). Observation from an ecological perspective. *TESOL Quarterly*, 31(4), 783–787.
- Van Lier, L. (2000). From input to affordance: Social-interactive learning from an ecological perspective. In J. Lantolf (Ed), *Sociocultural theory and second language learning* (pp. 245–259). Oxford: Oxford University Press.
- Van Lier, L. (2004). The semiotics and ecology of language learning: Perception, voice, identity, and democracy. *Utbildning & Demokrati*, 13(3), 79–103. Retrieved from: <https://www.oru.se/globalassets/oru-sv/forskning/forskningsmiljoer/hs/humus/utbildning-ochdemokrati/2004/nr-3/leo-van-lier---heterogeneity-multilingualism-and-democracy-.pdf>
- Van Lier, L. (2007). Action-based teaching, autonomy, and identity. *International Journal of Innovation in Language Learning and Teaching*, 1(1), 46–65. doi: 10.2167/illt42.0

- Van Lier, L. (2010). The ecology of language learning: Practice to theory, theory to practice. *Procedia - Social and Behavioral Sciences*, 3(2010), 2–6. doi: 10.1016/j.sbspro.2010.07.005
- Vygotsky, L. S. (1934/1987). *Thinking and speech: The collective works of Lev Vygotsky (Vol 1)*. New York, NY: Plenum Press.
- Winter, P. (2011). Coming into the world, uniqueness, and the beautiful risk of education: An interview with Gert Biesta by Philip Winter. *Studies in Philosophy and Education*, 30, 537–542. doi: 10.1007/s11217-011-9254-7.
- Woodhouse, J. L., & Knapp, C. E. (2000). Place-based curriculum and instruction: Outdoor and environmental education approaches. Retrieved from <https://files.eric.ed.gov/fulltext/ED448012.pdf>
- Wright, P. W. D., Wright, P. D., & Heath, S. W. (2003). *Wrightslaw: No Child Left Behind*. Hartfield, VA: Harbor House Law Press.
- Wright, S. (2005). Governance as a regime of discipline. In N. Dyck (Ed.), *Exploring regimes of discipline: The dynamics of restraint* (chap 5). Oxford, UK: Berghahn.
- Zink, R. (2014). John Dewey and education outdoors: Making sense of the ‘educational situation’ through more than a century of progressive reforms. *Australian Journal of Outdoor Education*, 17(2), 54–55.

Authors

Karen Bjerg Petersen, PhD, is an associate professor at the Danish School of Education, Aarhus University, Denmark. She is affiliated to the research unit, *Pedagogy on the Edge*, investigating interventions and projects focusing on inclusion of marginalized and vulnerable youth. Her areas of expertise include diversity in education and society, intercultural learning, and second language acquisition. She is the current editor of JISTE.

DeeDee Mower, PhD, is an assistant professor of teacher education at Weber State University in Ogden, Utah, USA. She specializes in teaching social studies and literacy strategies to elementary preservice teachers. She begins her tenure as one of the associate editors of JISTE with the next edition.

IMPACT OF ADIZES'S TEAM ROLES ON COLLABORATION, DISAGREEMENTS, AND
SUCCESS IN STUDENT ENTERPRISES –
TEAMWORK PEDAGOGY IN HIGHER EDUCATION

Ida Ulrikke Valand and Tormod Bjørkkjær
University of Agder, Norway

Abstract: *This study examines Adizes's management model implemented in student enterprise teams among undergraduate students at the University of Agder, Norway, exploring factors that affect the collaborative process. As Adizes's model claims four team roles (integrator, administrator, producer, entrepreneur) are required for effective and targeted collaboration, the researchers hypothesized that student enterprises with four roles present would collaborate better than teams with fewer roles present. Prior to commencing the student enterprise, each student categorized themselves according to these four roles. Eleven student enterprise teams were interviewed regarding their collaborative process. The four roles were represented to different extent in each team. Students reported collaborative benefits when having all four roles represented in the group. Most students ranked collaboration and ownership to business idea high and reported fruitful team discussions with only a few teams experiencing conflicts. Due to limited variance, further research is needed to investigate the hypothesis.*

Key words: student enterprise, Adizes management model, collaboration, teamwork

**Collaboration as an Essential Skill in the
Post Nation State Era**

Communities as well as nations are changing rapidly these days with globalization being one of the main drivers of this global evolution. Adapting to new prerequisites and collaborating with people from different cultural backgrounds is becoming the mainstay of everyday life. Teamwork or collaboration is an essential 21st century skill across all workplaces and organizations (Riebe, Girardi & Whitsed, 2016), which is highly relevant for future teachers and health professionals within food and nutrition both in Norway and abroad, for instance in multidisciplinary tasks (Fanzo et al., 2015; Norwegian Ministry of Education and Research [NMER], 2017). One way of training for real life scenarios and preparing for challenges of tomorrow is by implementing entrepreneurship in teaching curriculum in higher education, which is in

focus in Norway (NMER, Ministry of Local Government and Regional Development [MLGRD] & Ministry of Trade and Industry [MTI], 2006; 2009). According to The European Parliament & the Council of the European Union (2006), entrepreneurship has been defined as one of eight key competencies required for lifelong learning and can be defined as

[...] a dynamic and social process where individuals, alone or in collaboration, identify opportunities for innovation and act upon these by transforming ideas into practical and targeted activities, whether in social, cultural or economic context (NMER, MTI, & MLGRD, 2006, p. 4).

Implementing entrepreneurship in teaching curriculum and pedagogy is essential within both teacher education (Haara & Jenssen, 2016) and the food and nutrition field (Mann & Blum, 2004) and has been successful at several universities for a number of years,

including the University of Agder (UiA) (Aarek & Ask, 2012; Ask, Valand & Aarek, 2019).

A central feature of entrepreneurship is collaboration or teamwork involving communication between humans. According to Vygotsky's sociocultural theory of learning, humans learn in a social process involving communication (Vygotsky, 1978). This social constructivist way of thinking, where knowledge is not reproduced, but produced, is essential in pedagogical entrepreneurship where the right answer may not be known for teacher nor student. Similarly, constructivist thinking is used in group or team approaches such as collaborative and cooperative learning where groups as well as individuals are accountable for learning and outcome, resulting in enhanced social collaboration and productivity (Gillies, 2014; Laal, 2003). The former mentioned teamwork pedagogy approaches have been extensively reviewed in the context of higher education by Riebe et al. (2016).

Team Collaboration

Working in teams per se in a learning environment is not necessarily functional, especially in the case of random ad hoc groups, as reviewed by Gillies (2014). It is known that low-ability students learn more in heterogeneous groups with a blend of low, medium, and high-ability students, while medium-ability students benefit more from homogenous ability groups, and finally the high-ability students thrive in all sorts of groups (Lou et al., 1996). Size matters too, as smaller groups rather than somewhat larger groups seem to yield higher achievement in learning settings (Gillies, 2014). Based on the researchers' experience, an important question for many university teachers is how to implement effective teamwork, as students can be quite vocal about their dislike for

group assessments (Taylor, 2011). Many students tend to collaborate with their friends, whom they like and know well, thus avoiding conflicts and social loafing (Riebe et al., 2016). This student response begs the question if a more targeted team composition process might be more effective in higher education situations.

Setting of Current Practice-Based Research

The research reported in this article was situated in an undergraduate applied science course in food and nutrition and teacher education in home economics respectively at UiA, spring 2017. These two courses are relatively new program initiatives that assess groups of students' abilities to plan and operate a student enterprise (SE) during one semester of their degree program. The two courses comprise the regular entrepreneurship education offered at the researchers' institute, and they have not been research evaluated previously. The primary aim of the SE is to develop and market a product or service for the food, nutrition, and/or sports industry. A main purpose of the courses was for students to learn to collaborate effectively in their SE teams, and this process was an important aspect of the SE. Each SE team had a supervisor at UiA, and a mentor from the practice field besides access to a local branch of a national entrepreneurship organisation; Ungt Entreprenørskap (Young Entrepreneurship; www.ue.no).

Team Roles in Enterprises

New enterprises are often wrongly associated with being formed by one person, the creative entrepreneur, and rather often, a team is behind such enterprises (Aldrich, Carter, & Reynolds, 2004; Davidsson & Honig, 2003). As in SEs, different tasks and roles need to be fulfilled. In theory, collaboration can be

productive, but in practice, different goals among team members may induce conflicts (Halfhill, Sundstrom, Lahner, Calderone, & Nielsen, 2005; Zhou, Hu, & Zay, 2015). These conflicts may be attributed to the fact that human personality is varied. While there are different personality models like the Big Five (Saucier & Goldberg, 1998), the fields of psychology and personalities are beyond the scope of the present study. In the previously mentioned courses at UiA, they have for some years used a team management style model based on Adizes (1976; 2004) in a setting of targeted SE teams.

Adizes's (1976; 2004) classical management style classification is a research-based model, which describes four main roles of management that must be performed to prevent mismanagement in organisations or companies. A general description of the four roles—integrator, administrator, producer, and entrepreneur—are as follows: the *integrator* is good at communicating, dedicated to creating a pleasant and team-oriented working environment, listens to the individual's opinion, but avoids conflicts; the *administrator* is analytical, accurate, likes planning and routines, yet can forget to involve other people; the *producer* is clear, resolute, result- and action-oriented, but can ignore good training prior to action; and the *entrepreneur* is enthusiastic, flexible, solution- and action-oriented, however their ideas and solutions can often be unrealistic. Adizes concluded that a person rarely excels at all four roles in a good way as a business manager, and at some point, starts to mismanage. Thus, the organization or company will suffer detrimentally over time, implying that the managerial role is too difficult for one person to perform alone. In SEs at UiA, the researchers' experience was that students almost always decide on issues in a joint manner, even though one student may be the group leader. In this respect, a team could potentially possess all four roles

according to Adizes and thus work effectively and goal-oriented, which is a concept used in SEs at UiA. Based on the researchers' general experience and Adizes's (1976; 2004) work, students typically identify themselves with one or two main roles, but it can occur that all the above four roles are present in one student. The Adizes's model has been implemented at UiA for students to reflect upon how they contribute in a SE team. When choosing their own team, they may thus possibly not only work with friends they know well but think of other students' roles or attributes according to the model of Adizes as well, before deciding the team composition.

The first author of this article convened the SE course for nutrition students, and the authors primarily wanted to understand how the four roles, used as a basis in teaching, impact collaboration in SE teams. Secondly, the authors were interested in student ownership to business idea, occurrence of conflicts or disagreements, and SE success. To the researchers' knowledge the Adizes's model has not been used in this respect previously, and the rationale was to possibly better understand and improve teaching practice with an eye on the students' perspectives on collaboration in SE teams. Based on Adizes's model (1976; 2004), the researchers hypothesized that SEs with four team roles present would collaborate well and thus excel compared to SEs containing only one, two or three roles.

Research Methodology

Either teacher education students in home economics or nutrition students from UiA comprised the SEs. They initially received written and oral information about the study by the first author. All 12 SEs from the two courses were asked to participate, and if willing, each student filled out a questionnaire regarding how they would

classify themselves according to the Adizes's (1976; 2004) four roles. At the beginning of the courses (January), the students attended a lecture on the four roles and their qualities of collaboration as described above. At the end of the courses, a written project report of their work was delivered as an exam and given grades. At the start of the study (January), the students classified themselves from 0 to 100 percent for each role with 10 percent cut-off levels (i.e. 0%, 10% etc.). The total sum of the four roles should be 100% for each student. This classification was the basis for a group interview, performed in the early stages of SE team collaboration (February-March). At the end of the courses (May, main sampling), a similar group interview and team role classification was performed. The SE teams were interviewed to get a thorough understanding of the collaboration, ownership to business idea, occurrence of disagreements, conflicts, and successes that occurred. When appropriate, the students provided a quantitative measure of variables (i.e. evaluation of collaboration, ownership to business idea and success) during the interview. This quantification was implemented in order to detect possible differences between both students in each SE and the different SEs respectively.

In this project, a combination of qualitative and quantitative methods was used to investigate the impact of team roles on collaboration, disagreements or potential conflicts, and successes. As mixed methods increase the width and depth to which the research questions may be examined, the credibility of the research findings may be strengthened (Hesse-Bieber, 2010, p. 3–6).

Interviews

The SE team interviews were performed in a private room and lasted 25 to 40 minutes. The students were informed about the purpose of the interviews, and that their participation in

the study would not affect their grades. The participants were granted confidentiality and could withdraw from the study at any time without having to give a reason. It was underlined that the goal was merely to investigate the impact of team roles on SE team collaboration, not to search for potential bad collaboration or conflicts. A semi-structured interview guide, mostly with open-ended questions, was used. The interview guide consisted of individual and team questions, and follow-up questions were asked when appropriate. Individual and group questions were sampled simultaneously due to practical issues (e.g. time constraint). Questions in the first interview guide sought information on the current situation, while questions in the later (main) interview guide investigated the possible changes from the first interviews and the whole SE collaboration process. Individual questions focused on SE team roles, ownership to business idea (a sense of belonging; being passionate about it), personal goal with SE, expectations for own and other students work input in SE, and collaboration issues. Students' goals and expectations were investigated regarding possible impact on collaboration. Team questions focused on disagreements and potential conflicts and what solutions were made in case of the latter. Furthermore, the impact of each role on SE team collaboration was investigated by means of a focus discussion in the last interviews.

Ownership to business idea and team collaboration were also individually graded by the students at both interviews from 0 to 100%, with a 5 percent cut-off points (50%, 55% etc.). In the last interviews, success rate (e.g. number of products sold) was evaluated with each SE ranging 100% as the initial goal of the SE with a 10 percent cut-off points (50%, 60% etc.). The interviews were recorded digitally using a tape recorder. Students were given identification letters (A,

B, C etc.) as well as the SEs (1, 2 etc.), and they were asked not to reveal sensitive information. During team interviews, one of the authors referred the conversation in real time, and afterwards, a written summary of each interview was discussed between the researchers. The interview recordings were listened to afterwards to secure full coverage of data before the recording was deleted.

Data Analysis

The quantitative data from the role classification were plotted in Microsoft Excel. When a student classified him-/herself as mostly an integrator for instance, such a term was used for this student. To simplify and clarify the presentation of the distribution of SE team roles, mean team roles were calculated for all SEs, as each student's role was reported in quantitative numbers. Also, the skewness of the distribution of mean team roles in each SE was calculated by finding the difference between mean value and 25 for each team role and summarizing these numbers. The SE closest to 25% of each role had the most even mean role distribution. To compare SEs, mean evaluation of collaboration, success rate, and ownership to business idea were also calculated and plotted in Microsoft Excel. Interview data were processed manually by both authors, based on the semi-structured interview guide, and all findings were categorised, analysed, and interpreted in the urge to understand the SE team collaboration phenomena and team processes. Relevant quotes were translated from Norwegian to English. The aim of the presentation of results is to represent the students' thoughts and experiences.

Results and Discussion

All invited students (n=51) classified themselves according to the four team roles, and 11 SEs (n=47; 92 %) were interviewed in groups at the initial sampling. SE5 did not

attend any interviews and was excluded from the data analyses. Four SEs (n=19) dropped out before the last interview, mainly due to exams and time constraint. A few students from some groups were prevented from attending interviews, but the researchers chose to conduct the interviews, nevertheless. In these cases, remaining members of the SE were asked whether they believed other opinions might appear if all members were present, but they all answered no. As only two of five students in SE4 were represented at the last interview, quantitative data from the first interview are shown. Emphasis has been put on data from the later phase interviews due to more collaboration experience, and SEs with particularly interesting results concerning the research questions have been highlighted.

The main agenda of this practice-based research was to investigate the impact of SE team composition regarding Adizes's (1976; 2004) four roles on collaboration, disagreements and success, thus distribution of team roles in all SEs will be presented. As the hypothesis was that team composition affects team collaboration and SE success based on Adizes's work, it was important to investigate potential differences in team role distribution among SEs. To compare SEs, a list of the most to the least even team role distribution will be presented. Further, mean evaluation of ownership to business idea, collaboration, success, and occurrence of conflicts or disagreements for each SE will be listed. Because all SEs contained four team roles and the variance is limited, data will mainly be presented for each SE team rather than individual students.

Distribution of Team Roles in Student Enterprises

The SEs consisted of 3-6 students, mostly 4 students (Table 1, Column 1). According to Lou et al. (1996), groups of 3-4 students may

achieve better outcomes compared to larger groups of 5-7 students. The mean distribution

of team roles in each SE with minimum and maximum values is presented in Table 1.

Table 1
Mean Distribution of Team Roles (percent) in Student Enterprises

| | Integrator | Administrator | Producer | Entrepreneur |
|----------------------|------------|---------------|------------|--------------|
| SE1 (n=3) | 30 (10-50) | 40 (30-50) | 20 (10-40) | 10 (0-20) |
| SE2 (n=4) | 18 (10-30) | 28 (10-60) | 25 (10-40) | 30 (10-50) |
| SE3 (n=5) | 22 (0-40) | 38 (10-80) | 36 (20-50) | 4 (0-10) |
| SE4 (n=5) | 34 (20-50) | 20 (0-30) | 20 (10-30) | 26 (10-70) |
| SE6 (n=4) | 15 (0-30) | 43 (20-60) | 35 (10-80) | 8 (0-20) |
| SE7 (n=4) | 18 (10-30) | 28 (10-50) | 40 (20-50) | 15 (10-30) |
| SE8 (n=4) | 28 (0-80) | 15 (0-40) | 33 (20-60) | 25 (0-50) |
| SE9 (n=4) | 23 (10-40) | 30 (20-60) | 38 (20-50) | 10 (0-20) |
| SE10 (n=4) | 38 (10-50) | 23 (0-30) | 13 (0-30) | 28 (10-60) |
| SE11 (n=4) | 30 (10-50) | 20 (10-40) | 25 (0-60) | 25 (0-50) |
| SE12 (n=6) | 23 (0-40) | 33 (20-50) | 25 (10-60) | 18 (0-30) |
| Mean, all SEs (n=47) | 25 (0-80) | 29 (0-80) | 28 (0-80) | 18 (0-70) |

Note: SE2-4, SE9, SE12: Data from the first interview. SE1, SE6-8, SE10-11: Data from the last (main) interview. Data are presented as means with minimum and maximum values. SE, student enterprise.

As Table 1 illustrates, all four roles are represented in all SEs, thus limiting the variance, although SE3 and SE6 have very little entrepreneur characteristics (4% and 8%, respectively). To the researchers' knowledge, no other studies have reported such data using Adizes's (1976; 2004) model before. SE6 is the SE with the least even mean distribution of roles with an overweight of administrator characteristics (43%). In SE11, however, the role distribution is relatively even. Overall, the administrator

and producer roles are most commonly represented (29% and 28%, respectively) among all SEs, and the entrepreneur is the least represented role (18%).

To better illustrate the variation in mean team role distribution among SEs, a graphical presentation of the mean distribution of roles is presented in Figure 1. Whereas, Figure 2 shows the ranking of the SEs from most to least even mean distribution of roles.

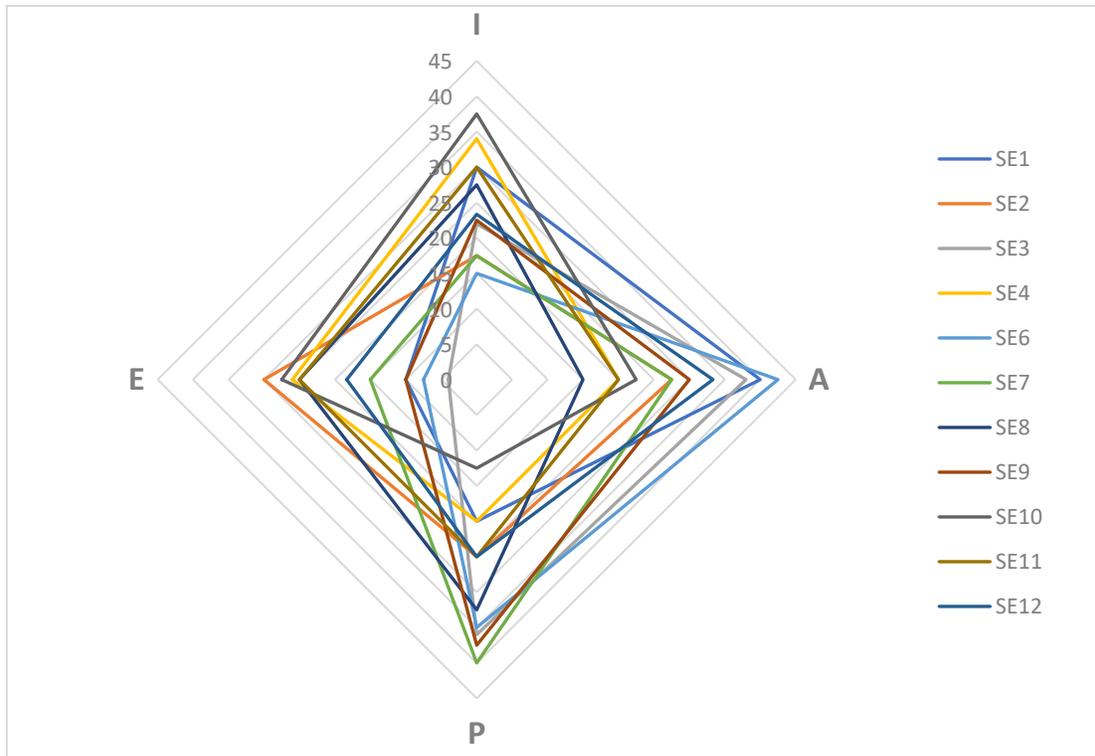


Figure 1. Mean distribution of team roles (percent) for all 11 SEs. SE2-4, SE9, SE12: Data from the first interview. SE1, SE6-8, SE10-11: Data from the last (main) interview. Roles are identified as I–integrator; A– administrator; P–producer; E–entrepreneur.

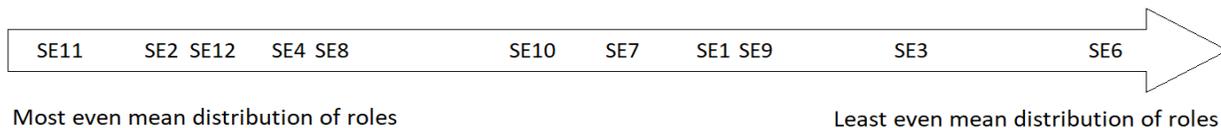


Figure 2. Ranking of SEs from most to least even mean distribution of team roles.

Evaluation of and Reflections about Ownership to Business Idea, Collaboration, and Success Rate in SEs

In Table 2, mean evaluation of ownership to business idea, team collaboration, and success rate in percentage are presented. Table 2 shows that most SEs ranked both ownership to business idea and team collaboration relatively high, and overall, collaboration was ranked higher than ownership to business idea. Although mean distribution of team roles varied among the

SEs, all four team roles were represented in all SEs to some extent (Table 1). During interviews, many students pointed out that all team roles were important in the SE team. For example, student C in SE4 said

It was the entrepreneur (student D) who came up with the idea at all, so without him/her we would probably have done something completely different today. So, in that respect, I would say that we have been very dependent on this person. We could always have thought of something else, but probably not as

creative. But in general, I would say that all roles are very important for collaboration – e.g. without the producer, little would be done. We have also depended on the structured one [administrator] to set up plans etc. The integrator is the glue of the team...; all of them have been important contributors.

SE6 also expressed that all four roles were important, and despite being the SE with the

least even mean role distribution, they had not missed more entrepreneur characteristics as they came up with the right business idea very early in the SE process. They admitted however that all of them probably have more entrepreneur characteristics than they “dared” to report. All of them had been creative in their own way. SE8 told that none of the roles excelled, and that all four roles had been important for wellbeing, collaboration, and progress in the SE.

Table 2
Mean Evaluation of Ownership to Business Idea, Collaboration, and Success

| Student Enterprise | Means | | Success |
|--------------------|----------------------------|---------------|---------|
| | Ownership to Business Idea | Collaboration | |
| SE1 | 83 (80-90) | 65 (60-70) | 75 |
| SE2* | 77 (50-100) | 88 (85-90) | |
| SE3 | 70 (60-80) | 87 (85-90) | |
| SE4* | 75 (70-80) | 76 (75-80) | 600** |
| SE6 | 99 (95-100) | 95 (95) | 200 |
| SE7 | 48 (40-50) | 75 (60-80) | 60 |
| SE8 | 96 (90-100) | 100 (100) | 200 |
| SE9 | 75 (65-85) | 93 (90-100) | |
| SE10 | 80 (60-90) | 96 (95-100) | 70 |
| SE11 | 100 (100) | 86 (80-90) | 150 |
| SE12* | 92 (80-100) | 100 (100) | |

Note. Data are presented as means with minimum/maximum values and are presented in percent (0-100%). The evaluation of success is also in percent (100%, as expected). SEs 2, 3, 4, 9, 12: Data from the first interview. SEs 1, 6, 7, 8, 10, 11: Data from the last (main) interview.

*Data from one student in the SE is missing

** Data from the last interview; only two of five students represented in interview

Discussion. The fact that all SEs contained all roles may possibly explain the high evaluation of collaboration in most SEs based on Adizes’s (1976; 2004) model suggesting all roles are important to reach a common goal. This result corresponds to the students’ reflections in interviews and a Norwegian study by Brattbakk and Martinsen (2014). Interestingly, according to Main (2010) and Sturner, Bishop, and Lenhart (2016), SE teams where students have divergent goals

and expectations show lack of good collaboration. In our study however, most team members had rather similar goals and expectations. Most students’ main goal was to learn from the SE process, and they anticipated that both themselves and the others would contribute and put down an effort, which may indicate a focus on collaboration and distribution of tasks.

Another factor of note may be the specific presence of integrator characteristics in all groups, which Adizes (1976; 2004) highlights as significant for achieving collaboration and thus goals. SE7 had the lowest evaluation of ownership to business idea and success and among the lowest evaluation of collaboration. This team did not prioritise the SE very high, and during the last interview, two of the students mentioned that motivation and thus collaboration probably could have increased if they had focused more upon doing nice things together. Most students in this team expressed that they identified themselves more with the integrator role in their spare time but less in the SE setting. One student suggested that the collaboration could have been more effective if the integrator was more present in the team; however, the overall data are not conclusive in this respect. Importantly, most groups were friend groups, and the fact that collaboration difficulties could potentially lead to less SE success and lower grades may have contributed to the good collaboration in most SEs.

It seems that most SEs distributed tasks according to each students' strengths and abilities, which may correspond to the Adizes's (1976, 2004) four team roles. Furthermore, several students expressed that their role adapted to what was needed in the SE. A student in SE1, for example, noticed the lack of team progress and started automatically to take the lead and became more resolute, despite being an administrator. This SE lacked a clear producer, thus the student adapted to the situation, as this student was the one with the most producer characteristics in this team.

No obvious trends regarding team roles and success rate of SEs can be seen. Out of the six SEs with complete datasets, a trend may however be observed regarding ownership to business idea, collaboration, and success (Table 2). SE1 and SE7 ranked both

ownership, collaboration and success rate relatively low when compared to other SEs. SE10 had high collaboration, yet a relatively low ownership and the success rate is below expectations (< 100%). Ownership to business idea may affect the success rate in SEs because students with high ownership to business idea prioritise the SE and work hard, which is essential to achieve success. Earlier studies indicate that focusing on teamwork rather than finding the best business idea might actually obstruct success (Carson, Tesluk, & Marrone, 2007; Prewitt, Walvoord, Stilson, Rossi, & Brannick, 2009). After all, the goal in the entrepreneurship education is not primarily to achieve success but to learn from the SE process.

Occurrence of Disagreements and Conflicts in Student Enterprises

It is not surprising that the evaluation of team collaboration varies among SEs as working together may present challenges both professionally and relationally (Halfhill et al., 2005; Taylor, 2011; Zhou et al., 2015). SEs 7, 8, and 10 did not report any conflicts or disagreements, but SEs 1, 2, 3, 6, 9 and 12 expressed that small disagreements had occurred. Students in SE4 communicated that disagreements did occur in the beginning, and in the later phase, even loud discussions arose. Collaboration had been difficult over time, but they were still friends. SE11 reported conflicts at start, but the collaboration improved when they decided upon the business idea.

In some SEs, e.g. SE8 and SE11, the individual team role distribution was scattered, while other SEs, such as SE6 and SE7, were more aligned. To exemplify, in SE8, a dominant integrator, administrator, producer, and entrepreneur was found, while SE6 consisted of many administrators and one producer (see Figure 3).

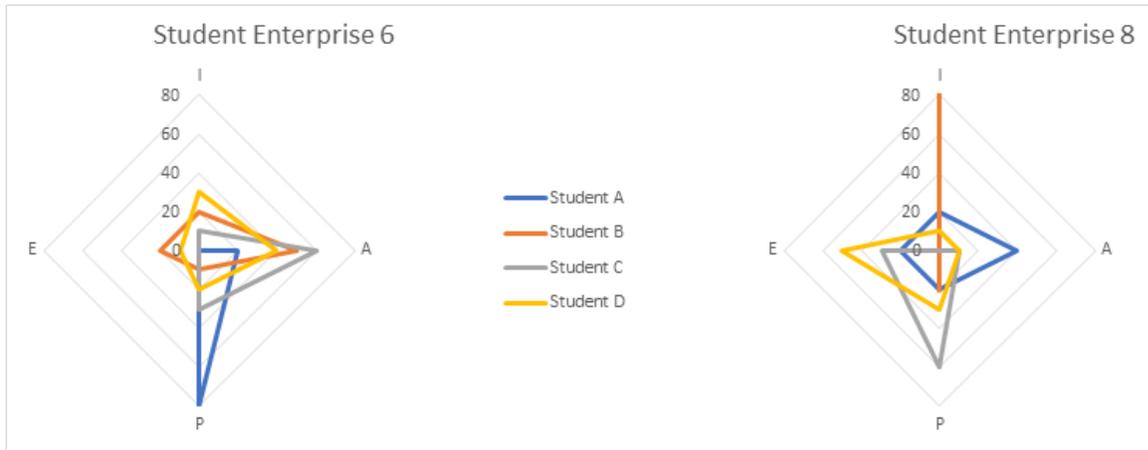


Figure 3. Individual distribution of team roles (percent) for student enterprise 8 and 6. Data from the last (main) interview. Roles are identified as I–integrator; A– administrator; P– producer; E–entrepreneur.

Discussion. Halfhill et al. (2005) showed that a great variance of personality composition in groups (roughly equivalent to different team roles in this study) affects the effectiveness negatively. In our study, no clear correlation between variance between team roles and evaluation of collaboration was observed, but it may seem that some of the SEs with very different roles or where one student stands out from the rest, experienced more conflicts. This result was observed in some but not all SEs with scattered individual roles. Yet sober discussions occurred in all SEs, and most of them reached solutions as a team rather than creating conflicts. Several students appreciated these discussions because they represented a possibility to find the best solutions. This illustrates a positive perception of discussions rather than a focus on disagreement. Students in SE6, for example, expressed that it was not negative that some students stood out from the others. It was more important to be different, and this reflects the general opinion of most SE teams.

Strengths and Weaknesses of the Study

In this study, a low drop-out rate increased validity of results. Data from the late phase interviews were more valid than the early interviews, but missing data limited our study. One of the strengths of this study was the use of mixed methods (Hesse-Bieber, 2010, p. 3–6). The researchers’ role as interviewers was clarified at the start of the interviews; although, it may potentially affect the results that one of them was the students’ teacher.

Defining oneself in different team roles may be challenging especially for young students who potentially do not know themselves very well as their personality is developing. Other aspects are that students may choose a role they want to emphasize and try to live up to, or that the interviewees wanted to appear more collaborative or team oriented than they were, as shown earlier (Srivastava & Banaji, 2011). Furthermore, many variables in the study may be difficult to estimate objectively, especially the degree of success. SEs were asked to estimate the success according to their initial expectations; hence, it may be

easier for SEs with low ambitions to achieve success. Finally, the fact that the SE provided material for an exam paper in which poor collaboration may result in a bad grade and that the evaluation of team collaboration is subjective, combined with little variance of team role data, implies caution about the generalisability of the results.

Conclusion

In this article, the influence of team composition regarding four team roles—integrator, administrator, producer, and entrepreneur—on collaboration in SEs has been investigated. One finding was that most SEs collaborated well, possibly related to the fact that all SEs contained all four team roles previously described as important in enterprise teams. However, limited variance among SEs restricts the extent to which we can focus on the importance of individual team roles for SE team collaboration. The hypothesis that SEs with four roles present would excel compared to teams with only one, two, or three roles, cannot be properly accepted based on findings in this study, as none of the SEs lacked one or more roles completely.

Overall, few disagreements and conflicts occurred in the SEs. Disagreements or potentially conflicts may, however, not necessarily diminish success because fruitful discussions may appear and increase the opportunity to reach the best solutions. Strong ownership to business idea may seem to increase the SEs' success more than high evaluation of collaboration; although, evaluation of success was highly individual.

Future Perspectives

Although achieving success is not the main focus of the curriculum initiative in SE, the finding that a strong ownership to business idea may increase success was interesting in a teaching perspective. Encouraging students to team up around a business idea that they like, believe in, and belong to, may encourage them into making a collaborative effort. Hence, students may possibly work better as a team, according to Adizes's (1976; 2004) model, and learn from their team members, which is a hallmark of cooperative learning (Laal, 2013). This effort may prevent loss of motivation and possibly secure a good team spirit and thus collaboration. In their future working life, candidates (e.g., in food and nutrition) will have to collaborate and work towards common goals and targets set by themselves or others (Fanzo et al., 2015). Although variance among students in a SE in some cases increased the conflict rate, this variance did not seem to affect rate of success. Indeed, students seemed to enjoy discussions and giving and getting input suggesting the pros outweigh the cons of a teaching practice where diversity among SE groups was encouraged. As many students pointed out that all Adizes's four roles were important in the SE team, further education should continue to encourage students to create SE teams according to these team roles, rather than teaming with their friends. Yet more research is needed to further investigate the impact of team roles on collaboration, disagreements and success in SE teams with a more varied role distribution.

References

- Aarek, I., & Ask, A. M. S. (2012). Student experiences of the value of a student enterprise programme. *Journal of the International Society for Teacher Education*, 16(1), 62–70.
- Adizes, I. K. (1976). Mismanagement Styles. *California Management Review*, 19(2), 5–20.
- Adizes, I. K. (2004). *Management/mismanagement styles. How to identify a style and what to do about it*. Santa Barbara, CA: The Adizes Institute.
- Aldrich, H. E., Carter, N. M., & Reynolds, P. D. (2004). Teams. In W. B. Gartner, K. G. Shaver, N. M. Carter, & P. D. Reynolds (Eds.), *Handbook of entrepreneurial dynamics: The process of business creation*. Los Angeles, CA: Sage
- Ask, A. S., Valand, I. U., & Aarek, I. (2019). Implementation of action plans – Did the plans end up in a drawer? *Journal of the International Society for Teacher Education*, 23(1), 27–38.
- Brattbakk, I., & Martinsen, M. F. (2014). *Personligheter i tverrfaglige team: En kvantitativ studie om samarbeid i tverrfaglige team*. (Unpublished master's thesis). Retrieved from <https://brage.bibsys.no/xmlui/handle/11250/271884> (In Norwegian)
- Carson, J. B., Tesluk, P. E., & Marrone, J. A. (2007). Shared leadership in teams: An investigation of antecedent conditions and performance. *Academy of Management Journal*, 50(5), 1217–1234. doi: 10.5465/amj.2007.20159921
- Davidsson, P., & Honig, B. (2003). The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing*, 18(3), 301–331. doi: 10.1016/S0883-9026(02)00097-6
- European Parliament and the Council of the European Union. (2006). Recommendation of the European Parliament and of the Council. *Official Journal of the European Union*. Retrieved from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32006H0962#document1>
- Fanzo, J. C., Graziose, M. M., Kraemer, K., Gillespie, S., Johnston, J. L., de Pee, S., ... West, K. P. (2015). Educating and training a workforce for nutrition in a post-2015 world. *Advances in Nutrition*, 6(6), 639–647. doi: 10.3945/an.115.010041
- Gillies, R. M. (2014). Cooperative learning: Developments in research. *International Journal of Educational Psychology*, 3(2), 125–140. doi: 10.4471/ijep.2014.08
- Haara, F. O., & Jenssen, E. S. (2016). Pedagogical entrepreneurship in teacher education – what and why? *Icelandic Journal of Education*, 25(2), 183–196.
- Halfhill, T., Sundstrom, E., Lahner, J., Calderone, W., & Nielsen, T. M. (2005). Group personality composition and group effectiveness: An integrative review of empirical research. *Small Group Research*, 36(1), 83–105. doi: 10.1177/1046496404268538
- Hesse-Biber, S. N. (2010). *Mixed methods research: Merging theory with practice*. New York: Guilford.
- Laal, M. (2013). Collaborative learning; elements. *Procedia – Social and Behavioral Sciences*, 83, 814–818. doi: 10.1016/j.sbspro.2013.06.153

- Lou, Y. Abrami, P., Spence, J., Poulsen, C., Chambers, B., & d'Apollinia, S. (1996). Within-class grouping: A meta-analysis. *Review of Educational Research*, 66(4), 423–458. doi: 10.3102/00346543066004423
- Main, K. (2010). Teamwork – teach me, teach me not: A case study of three Australian preservice teachers. *The Australian Educational Researcher*, 37(3), 77–93.
- Mann, L. L., & Blum, I. (2004). Entrepreneurship of dietetic program graduates. *Canadian Journal of Dietetic Practice and Research*, 65(4), 166–173.
- Norwegian Ministry of Education and Research. (2017). *The core curriculum – values and principles for primary and secondary education and training*. Retrieved from <https://www.regjeringen.no/contentassets/53d21ea2bc3a4202b86b83cfe82da93e/core-curriculum.pdf>
- Norwegian Ministry of Education and Research, Ministry of Trade and Industry & Ministry of Local Government and Regional Development. (2006). *See the opportunities and make them work – strategy for entrepreneurship in education and training 2004-2008*. Retrieved from https://www.regjeringen.no/globalassets/upload/kd/vedlegg/grunnskole/strategiplaner/see_the_opportunities_and_make_them_work_2204-2008.pdf
- Norwegian Ministry of Education and Research, Ministry of Local Government and Regional Development & Ministry of Trade and Industry. (2009). *Entrepreneurship in education and training - from compulsory school to higher education 2009-2014*. Retrieved from <https://www.regjeringen.no/globalassets/documents/action-plan-for-entrepreneurship-in-education-and-training-2009.pdf>
- Prewitt, M. S., Walvoord, A. G., Stilson, F. R. B., Rossi, M. E., & Brannick, M. T. (2009). The team personality – team performance relationship revisited: The impact of criterion choice, pattern of workflow, and method of aggregation. *Human Performance*, 22(4), 273–296. doi: 10.1080/08959280903120253
- Riebe, L., Girardi, A., & Whitsed, C. (2016). A systematic literature review of teamwork pedagogy in higher education. *Small Group Research*, 47(6), 619–664. doi: 10.1177/1046496416665221
- Saucier, G., & Goldberg, L. R. (1998). What is beyond the big five? *Journal of Personality*, 66(4), 495–524. doi: 10.1111/1467-6494.00022
- Srivastava, S. B., & Banaji, M. R. (2011). Culture, cognition, and collaborative networks in organizations. *American Sociological Review*, 76(2), 207–233. doi: 10.1177/0003122411399390
- Sturner, K. K., Bishop, P., & Lenart, S. M. (2016). Developing collaboration skills in team undergraduate research experiences. *Problems, Resources, and Issues in Mathematics Undergraduate Studies*, 27(3), 370–388. doi: 10.1080/10511970.2016.1188432
- Taylor, A. (2011). Top 10 reasons students dislike working in small groups... and why I do it anyway. *Biochemistry and Molecular Biology Education*, 39(2), 219–220. doi: 10.1002/bmb.20511
- Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press

Zhou, W., Hu, H., & Zey, M. (2015). Team composition of new venture founding teams: Does personality matter? *International Journal of Entrepreneurial Behaviour & Research*, 21(5), 673–689.

Acknowledgements

The authors of this article would like to express their deep gratitude to Dr. Katie Weir at Griffith University for valuable and much appreciated feedback in the writing process. Also, a sincere thank you goes to remaining participants of the paper group at ISfTE 38th Annual Seminar in Japan for educating discussions and helpful comments on the paper draft. Finally, the authors would like to acknowledge all the students who participated in this study.

Authors

Ida Ulrikke Valand is an assistant professor and PhD student at UiA, Norway. She lectures in nutrition and entrepreneurship. The aim of the doctoral research is to investigate the diet of university students and use this information to develop a course in diet literacy and food preparation skills.

Tormod Bjørkkjær holds a PhD in nutrition from University of Bergen, Norway (2009), and researches mainly school and kindergarten food issues. Scientific interests are e.g. entrepreneurship, health promotion, and sustainability. He has experience with teaching teacher education students in home economics and currently teaches public health and nutrition students at UiA.

CONCEPTUAL UNDERSTANDING AND APPLICATION OF DIFFUSION AND OSMOSIS:
AN ASSESSMENT OF PRE-DEGREE STUDENTS
IN A NIGERIAN UNIVERSITY

Adenike Julianah Oladipo
University of Lagos, Nigeria

Modupe Osokoya
University of Ibadan, Nigeria

Uchenna Udeani
University of Lagos, Nigeria

Abstract: *In this explorative study, a diagnostic test on diffusion and osmosis (DTDO) was developed and used to assess pre-degree students' conceptual understanding and application of diffusion and osmosis in biology. The 25-item DTDO is a two-tier test—adapted from Odom and Barrow's (1995) Diffusion Osmosis Diagnostic Test (DODT)—developed and validated with the Nigerian curricula of both senior secondary school and university pre-degree programme. Cronbach alpha was used to estimate the internal consistency of the items. The study adopted descriptive survey design. Homogenous clustered random sampling technique was used to get a sample size of 806 pre-degree students (476 biology majors and 330 non-biology majors) in a federal university in Nigeria. Data collected were analyzed using descriptive and inferential statistics. The findings revealed that only 27.02% of the students have conceptual understanding and application of diffusion and osmosis. Meanwhile, the students showed highest understanding and application in the concept of kinetic energy of matter (40.1%) and least were concepts of concentration and tonicity (12.8%) compared to other allied concepts. It is evident that both genders had a fairly similar conceptual understanding and application of diffusion and osmosis. Biology majors had a slightly higher conceptual understanding and application than non-biology majors, the difference is however not significant. It is recommended that prior understanding and application of diffusion and osmosis should not be assumed at tertiary level and that teaching of the concepts should be enhanced using contemporary approaches and technology for all categories of students.*

Keywords: conceptual understanding and application, diffusion and osmosis in biology, pre-degree biology students, Nigeria

Introduction

Biology is a subject that engages students in various process skills such as observation, clarifying, interpreting and predicting events, designing experiments, organizing information, and reporting adequately. One primary function of biology teaching is to

help the students understand and apply biology concepts, principles, theories, and laws. However, researchers in science education have observed that mastery of concepts in biology is difficult to achieve among students, and worse still, is assessing abstract concepts such as diffusion and osmosis, which are prerequisites to

understanding other life processes (Fisher, Williams, & Lineback, 2011; Odom & Barrow, 1995; Oladipo & Ihemedu, 2016).

Due to the abstract nature of the concepts of diffusion and osmosis, many students find these concepts difficult to comprehend, make connections to previous knowledge, or to apply the concepts to real life situations. Difficulties in understanding these two processes have been shown in literature over the past decades (Christianson & Fisher, 1999; Odom & Barrow, 1995; Oladipo, 2009; She, 2004; Zuckerman, 1998). In the same vein, there is a dearth in conceptual assessment instruments in biology (Chi & Roscoe, 2002; D'Avanzo, 2008) though several authors have demonstrated the use of conceptual assessments for broader programmatic improvement including Garvin-Doxas and Klymkowsky (2008).

More than two decades ago, Odom and Barrow (1995) developed and applied a two-tier diagnostic test, named *Diffusion, Osmosis and Diagnostic Test (DODT)*, on college biology students to assess their understanding of diffusion and osmosis after a course of instruction. Their results revealed that the performance of the college biology majors was consistently poor, and scores obtained by college non-biology majors and high school students were even lower. Also, Fisher et al. (2011), while adopting DODT, developed a two-tier diagnostic tool containing 18 diffusion and osmosis named *Osmosis, Diffusion Conceptual Assessment (ODCA)*. The ODCA was administered to students in a public university, and they gave similar responses to those of DODT even 15 years later.

In another dimension, evidence from literature also indicates that assessment needs to be broadened (Busari, 2001; Sadler & Sonnert, 2016; Udeani, 2002). Similarly, a

significant number of teachers would agree that authentic assessment must include more than a single evaluation. Important decisions should be based on more than one sample of students' abilities. Furthermore, complex outcomes often require several assessment tasks so that students can demonstrate their understandings in a variety of contexts (Hiebert & Calfee, 1989).

The National Bureau of Economic Research (2005) and the National Science Foundation (2006) observed that female college students were 37 percent less likely than males to obtain science and engineering BAs, and females comprise only 25 percent of the science, technology, engineering, and math (STEM) workforce. Although progress is being made to increase female participation in many fields, UNESCO (2012) figures reveal that females make up a minority of the world's science researchers. In 121 countries with available statistics, women make up 29 percent of science researchers.

In Nigeria, Udeani (2010) reported that female enrollment thins out as it moves up the education hierarchy, and fewer women than men are enrolled in university science courses. According to Udeani, one of the most indisputable facts is that the world is characterized by gender unbalances in literally all facets of life, education inclusive. Other researchers have exposed gender disparities in education, while gender concern in education has been identified to cut across all levels of education and more especially in science and technology at the higher education level (Ekine, 2010; Rathgeber, 2009).

Non-biology majors are students who need to fulfill some biology requirements for the completion of their degree. These categories of students would be enrolled for degree courses in the sciences such as chemistry,

science laboratory technology, computer science, geology, and geophysics after their successful completion of the pre-degree programme. At the pre-degree level, all science students are offered physics, chemistry, mathematics, and biology and are exposed to diffusion and osmosis concepts in physics, chemistry, and biology. Generally, it is assumed that the background knowledge and attitudes of non-biology majors toward biology and approaches to biology classes are essentially different from that of biology major (Knight & Smith, 2010). Nonetheless, the assessment of the conceptual understanding of biology major and non-major is needed because diffusion and osmosis are cross cutting concepts.

Theoretical Framework

This present work hinges on the meaningful learning theory of Ausubel (1965) and constructivist learning theory (Crippen & Earl 2007; Duit & Treagust 2003; Lawson, Banks & Logvin, 2007). These two theories provide the framework for this study.

Theory of Meaningful Learning

The theory of meaningful learning propounded by Ausubel (1965) has had profound impacts on teaching, learning, and curriculum over the years. In Ausubel's view, to learn meaningfully, students must relate new knowledge (concepts and propositions) to what they already know. He pointed out that two things are necessary for understanding to occur: (a) the content must be potentially meaningful and (b) learners must relate it in a meaningful way to their prior knowledge. According to Ausubel, for potentially meaningful knowledge to become meaningful knowledge to a learner, it is usually subsumed under a broader, more inclusive piece of meaningful knowledge closely related to it. Learners come to

recognize relationships between concepts during the integrative reconciliation process (Novak, 1990). Hence, understanding and application of concepts are possible when there is meaningful learning.

Constructivist Theory of Learning

The constructivist theory has its roots in philosophy, sociology, and education. It is based on the fact that human learning is constructed and that learners build new knowledge upon the foundation of previous knowledge, experiences, observations, and interactions in a social setting until understanding and meaningful learning is facilitated. In a more comprehensive way, constructivism can be viewed, as a theory of meaning making, knowledge construction, and reconstruction that fosters conceptual understanding and which provides insight on how learners move along the pathway of their own worldview to scientific viewpoints using socio-cognitive anchors (Crippen & Earl 2007; Duit & Treagust 2003; Lawson et al., 2007)

Research Question and Hypotheses

The study was guided by a research question and two hypotheses:

What is the level of conceptual understanding and application of diffusion and osmosis among pre-degree students? and

H₀₁: There is no significant difference in the conceptual understanding and application of diffusion and osmosis between male and female pre-degree students.

H₀₂: There is no significant difference in the conceptual understanding and application of diffusion and osmosis between biology major and non-biology major?

Method

Development and Design

This study developed and validated a 25-item diagnostic test on diffusion and osmosis (DTDO). The DTDO is a two-tier test consisting of twelve original items obtained from *Diffusion Osmosis Diagnostic Test (DODT)* earlier developed by Odom and Barrow (1995), which was modified, as well as thirteen newly developed and validated items. It was necessary to add more items to the DODT in order for it to align well with the senior secondary school curriculum and also the university curriculum for pre-degree students in Nigeria. While maintaining the same conceptual areas, the DODT originally had two options to choose from for the answer but was modified to now have four options (three distractors and the correct

answer in multiple-choice question) for each of the items for only the first tier questions.

The thirteen newly developed items were initially 20 items on diffusion and osmosis, which were carefully selected from past (2002-2015) West African Examinations Council (WAEC) Biology (Paper1, Objectives) questions and restructured to fit into the two-tier diagnostic test. The 20 items covered the existing conceptual areas of the particulate and random nature of matter, concentration and tonicity, process of diffusion, and process of osmosis originally itemized by Odom and Barrow (1995) as shown in Table 1. Cronbach alpha was used to estimate the instrument reliability giving reliability coefficient of 0.86 by using IBM's SPSS software. DTDO and its relation to the initial concepts covered by the DODT are shown in Table 1.

Table 1
The Original and New Items Added to DTDO

| Concepts | Original Items on DTDO | New Items Added |
|---|------------------------|-----------------|
| The process of diffusion | 1, 5 | 13, 24, 25 |
| The particulate nature and random motion of matter | 2, 3, 6 | 16, 18, 22 |
| Concentration and tonicity | 4, 9 | 13, 21, 23 |
| Kinetic energy of matter | 7 | - |
| The process of osmosis | 8, 10 | 15, 17 |
| The influence of life forces on diffusion and osmosis | 11 | 20 |
| Membrane | 12 | 19 |

Table 1 indicates the original and new items added to DTDO. Altogether, the moderated and refined DTDO included 25, two-tier items, however, there was no item among the 13 newly added items on kinetic energy of matter because the Nigerian Science Curriculum merged it with particulate nature of matter and random motion of matter.

Administration of the Instrument

The diagnostic instrument was administered to 806 pre-degree students. The selection of the students was through stratified random

sampling technique, and it consisted of 476 biology majors and 330 non-biology majors of which were 390 were male and 416 were female. While attending senior secondary schools in Nigeria, the participants had received instructions on cell and environment/transport in animal and plant aspects of biology. Also, they had received one year instruction in biology, chemistry, and physics and were writing their final year diploma examination which was followed by the Joint Universities Preliminary Examinations Board (JUPEB) examinations in a Federal University in Nigeria.

Results

To answer the research question—What is the level of conceptual understanding and application of diffusion and osmosis among pre-degree students?—items were evaluated for both correct content choice

(understanding) and correct combination of content and reason (application) selected. An item was deemed correct on the DTDO if both the desired content and reason were answered correctly, which means that the student had acquired conceptual understanding of the particular concept.

Table 2
Mean and Standard Deviation of Correct Choice, Reason, and Combination of Biology Diploma Students in a Federal University

| Option | Mean | SD |
|---------------------|-------|-------|
| Correct choice | 44.34 | 14.90 |
| Correct reason | 42.02 | 13.49 |
| Correct combination | 27.02 | 14.12 |

The assessment of university pre-degree students’ conceptual understanding and application of diffusion and osmosis reveals that the average percentage of students who selected the correct choice (understanding) is 44.34%, while the average number of students who selected the correct reason

(application) is 42.04%, and the percentage number of students who selected the correct combination of choice and reason (understanding and application) is 27.02% indicating that less than half of the students considered have conceptual understanding and application of diffusion and osmosis.

Table 3
Percentage of Students Selecting Desired Correct Content, Reason, and Combination of Content and Reason for Conceptual Areas on the DTDO

| Conceptual Area | Test Items | Content Choice | Reason | Correct Combination |
|--|---------------------|----------------|--------|---------------------|
| i–The process of diffusion | 1, 5, 14, 24, 25 | 46.4 | 49.6 | 35.9 |
| ii–The particulate nature and random motion of matter | 2, 3, 6, 16, 18, 22 | 52.1 | 40.4 | 30.6 |
| iii–Concentration and tonicity | 4, 9,13, 21, 23 | 26.9 | 35.7 | 12.8 |
| iv–Kinetic energy of matter | 7 | 49.0 | 66.1 | 40.1 |
| v–The process of osmosis | 8, 10, 15, 17 | 47.9 | 34.7 | 22.9 |
| vi–The influence of life forces on diffusion and osmosis | 11, 20 | 39.1 | 42.9 | 27.3 |
| vii–Membrane | 12, 19 | 58.4 | 48.0 | 34.9 |

From Table 3, the range of correct answers for the first tier was 26.9% to 58.4%, while that of the second tier that deals with the reason varied from 35.7% to 66.1%. This result shows that students can often predict the application of concepts but have less

conceptual understanding about the underlying mechanisms. On combining both tiers, the correct responses dropped to a range of 12.8% to 40.1%. Figure 1 explores these data differently.

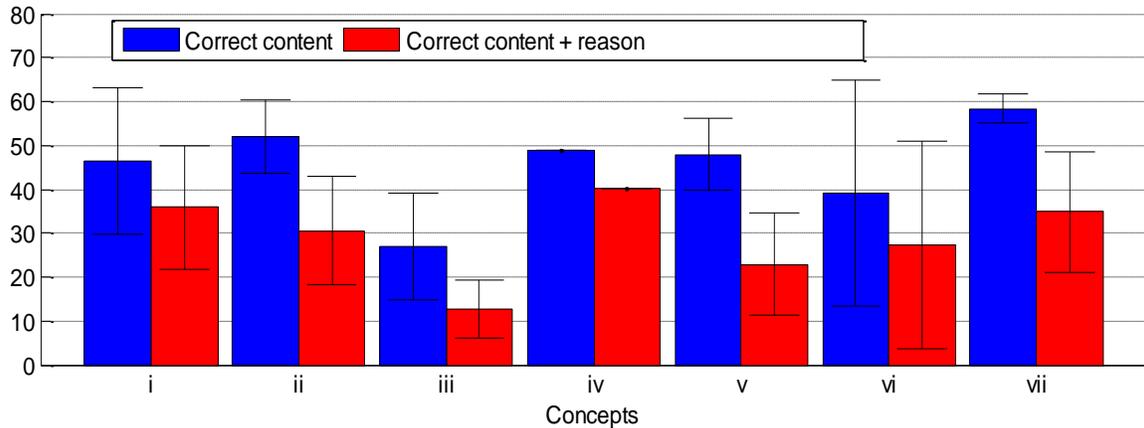


Figure 1. Bar plots with error bars showing percentage of students selecting the desired content and combination of content and reason.

In Figure 1, students showed higher conceptual understanding and application in the concept of kinetic energy of matter (40.1%) compared to other concepts such as the process of diffusion (35.9%), membrane (34.9%), particulate nature of matter (30.6%), influence of life forces on diffusion and osmosis (27.3%), and the process of osmosis (22.9%). The least amount of conceptual understanding and application was shown in the concepts of concentration and tonicity (12.8%). These results show that the level of conceptual understanding and application of concepts differs from one concept to another and quite unsatisfactorily.

According to Gilbert (1977), if a multiple-choice item has four to five distractors, understanding is considered satisfactory if

more than 75% of the students answer the item correctly. Bull and McKenna (2003) stated that the higher the number of distracters, the less likely it is for the correct answer to be chosen through guessing provided all alternatives are equally difficult. Consequent upon the results above, it is evident that the level of understanding and application of diffusion and osmosis among pre-degree students was very low suggesting that the students have not acquired satisfactory understanding and application of diffusion and osmosis.

To respond to Hypothesis 1—There is no significance difference in the conceptual understanding and application of diffusion and osmosis between male and female pre-degree students, see Table 4.

Table 4
Mean, Standard Deviation, and t-Test Result for Conceptual Understanding of Male and Female Students

| Group | N | Mean | SD | Df | T-stat | P value |
|--------|-----|-------|-------|-----|--------|---------|
| Male | 390 | 28.85 | 11.69 | 804 | -0.14 | 0.89 |
| Female | 416 | 29.60 | 11.90 | | | |

Table 4 shows that the mean score for male students in the conceptual understanding and application of diffusion and osmosis is 28.85 while that of female students is 29.60. The null

hypothesis was not rejected because the p-value (0.89) is greater than the α (0.05); therefore, there was no significant difference in the conceptual understanding and

application of diffusion and osmosis between male (28.85, 11.69) and female (29.60, 11.90) students, $t(804) = -0.14$, $p = 0.89$ at $\alpha = 0.05$.

Table 5 responds to Hypothesis 2—There is no significance difference in the conceptual understanding and application of diffusion and osmosis between biology major and non-biology major.

Table 5

Mean, Standard Deviation, and t-Test Result for Conceptual Understanding of Biology Major and Non-major

| Group | N | Mean | SD | Df | T-stat | P value |
|-----------|-----|-------|-------|-----|--------|---------|
| Major | 476 | 31.42 | 12.09 | 804 | 1.13 | 0.26 |
| Non-major | 330 | 25.99 | 11.36 | | | |

Table 5 shows biology major students had a slightly higher mean score with corresponding higher standard deviation (31.42, 12.09) than the non-majors (25.99, 11.36). Even though the conceptual understanding and application for both biology majors and non-majors was generally low, biology majors had a slightly higher conceptual understanding and application of diffusion and osmosis. The null hypothesis was not rejected because there was no significant difference in the conceptual understanding and application of diffusion and osmosis between biology major (31.42, 12.09) and non-biology major (25.99, 11.36), $t(804) = 1.13$, $p = 0.26$ at $\alpha = 0.05$.

Discussion

The results of this study reveal that pre-degree students could proffer accurate reasons (application) for a wrong content choice (understanding), thereby, having a wrong combination of both content and reason. This finding suggests that they could at times predict or guess the application of concepts but indeed have less or little conceptual understanding of the underlying mechanisms. Whichever way this result is perceived, a strong divide still exists between students' conceptual understanding and the application of diffusion and osmosis over two decades since the development of the DODT

by Odom and Barrow (1995) even though, one of the objectives of science teaching in Nigeria is to prepare the students to acquire the ability to apply scientific knowledge to everyday life (National Policy on Education, 2014). This paper is a confirmation of a wide range of research over the past decades, which demonstrated that student mastery of osmosis and diffusion is extremely difficult to achieve (Christianson & Fisher, 1999; Fisher et al., 2011; Garvin-Doxas & Klymkowsky 2008; Oladipo & Ihemedu, 2016; Oztas, 2014; Oztas & Oztas, 2012; She, 2004; Zuckerman, 1998).

The question remains—Why is it so difficult for teachers to effectively teach and students to successfully learn about diffusion and osmosis? Reasons may include the fact that these processes result from the constant, random motion of invisible particles, and a significant number of students struggle to comprehend such abstract ideas (Fisher & Williams, 2011). However, there is undeniable evidence that teachers still teach these abstract concepts using lecture method even though the contents and context of the curriculum place emphasis on field studies, guided discovery, laboratory techniques, and skills along conceptual thinking (Federal Ministry of Education, 2014). Taking the above into consideration, teaching strategies that emphasize the process of arriving at an

answer rather than simply requiring students to regurgitate the *right* answer are essential. Also, there is a need for a strategy that focuses on process not product and provides content for the information that students acquire and is effective and flexible (Ogundiwin & Oladipo, 2018; Oladipo, 2009). Hence, teachers of science subjects should go beyond teaching for factual information alone, they should embrace teaching for understanding and application of concepts.

The study also reveals that gender is not a significant determinant in the conceptual understanding and application of diffusion and osmosis among pre-degree students, which aligns with previous findings (Odom & Barrow, 1995, 2007; Oladipo, 2009; Oladipo & Ihemedu, 2016). Although, gender is no longer a significant determinant of science achievement, gender gaps have been long established to exist in the sciences in Africa and elsewhere in the world (Hill, Corbet, & St. Rose, 2010; Okoli, 2009; Udeani, 2010). Science educators should not rest on the achievement so far in closing the gap between males and female, rather they should continue until female students are as well-received in science classrooms as their male counterparts.

Similarly, performance of biology major was not significantly different from that of non-biology majors. This finding is an indication

that both major and non-major biology students had significant misconceptions of the process of diffusion and osmosis. Fisher et al. (2011) had previously found that the performance of both categories of students was similar. This finding is in contrast with other researchers' findings (Sundberg & Dini, 1993; Knight & Smith, 2010), which showed that non-biology majors can even perform better than majors. In another dimension, Odom and Barrow (1995) showed that the number of science courses taken at high school was not a significant covariance of students' understanding on the DODT.

Conclusion

The 25-item diagnostic test on diffusion and osmosis (DTDO) has, thus, turned out to be an essential tool, which could be used to assess the conceptual understanding of some abstract concepts with a view to addressing the problem of poor academic performance of Nigerian students in biology. It can be a tool to assess the effectiveness of teaching and learning outcomes of the biology curriculum in Nigeria. Additionally, it can act as an effective instrument used by tutors to get a prior knowledge of their students' scientific beliefs, capture students' thinking, plan lessons better, measure the potential success of their teaching, and enhance the scientific reasoning skills and achievement of biology students.

References

- Ausubel, D. (1968). *Educational psychology: A cognitive view*. New York: Holt, Rinehart, & Winston.
- Bull, J., & McKenna, J. (2003). *A blueprint for computer-assisted assessment*. London: Routledge.
- Busari, O. O. (2001). Validation of an assessment tool developed for measuring skills in chemistry teaching-learning process. *Education Review*, 8, 215–224.

- Chi, M., & Roscoe R. (2002). The processes and challenges of conceptual change. In M. Limón & L. Mason (Eds.), *Reconsidering conceptual change: Issues in theory and practice* (pp. 3–27). Dordrecht, The Netherlands: Kluwer Academic.
- Christianson, R. G., & Fisher, K. M. (1999). Comparison of student learning about diffusion and osmosis in constructivist and traditional classrooms. *International Journal of Science Education*, 21, 687–698.
- Crippen, K. J., & Earl, B. J. (2007). The impact of web based worked examples and self-explanation on performance, problem solving and self-efficacy. *Computer & Education*, 49(3), 809–821. doi:10.1016/j.compedu.2005.11.018
- D'Avanzo, C. (2008). Biology concept inventories: Overview, status, and next steps. *BioScience*, 58(11), 1079–1085. doi: 10.1641/B581111
- Duit, R., & Treagust, D. F. (2003). Conceptual change : A powerful framework for improving science teaching and learning. *International Journal of Science Education*, 6, 671–688. doi: 10.1080/09500690305016
- Ekine, A. O. (2010). *The impart of videotaped instructional strategy on pupils' interest and achievement on primary science in some selected schools in Oyo State* (Unpublished Ph.D. thesis). University of Ibadan, Nigeria.
- Federal Ministry of Education (FME). (2014). Lagos, Nigeria, NERDC press.
- Fisher, K. M., & Williams, K. S. (2011). *Concept inventories and conceptual assessments in biology (CABs): An annotated list*. Retrieved from http://www.sci.sdsu.edu/CRMSE/files/Concept_Inventories_in_Biology_20110325.pdf
- Fisher, K. M., Williams, K. S. & Lineback, J. E. (2011). Osmosis and diffusion conceptual assessment. *CBE—Life Sciences Education*, 10(4), 418–429. doi: 10.1187/cbe.11-04-0038
- Garvin-Doxas, K., & Klymkowsky, M. W. (2008). Understanding randomness and its impact on student learning: Lessons learned from building the biology concept inventory (BCI). *CBE Life Science Education*, 7(2), 227–233. doi: 10.1187/cbe.07-08-0063
- Gilbert, J. K. (1977). The study of student misunderstandings of the physical sciences. *Research in Science Education*, 7(1), 165–171. doi: 10.1007/BF02643123
- Hiebert, E. H., & Calfee, R. C. (1989). Advancing academic literacy through teachers' assessments. *Educational Leadership*, 46(7), 50–55.
- Hill, C., Corbett, C., & St. Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. Retrieved from https://www.aauw.org/aauw_check/pdf_download/show_pdf.php?file=why-so-few-research
- Knight, J. K., & Smith M. K. (2010). Different but equal? How nonmajors and majors approach and learn genetics. *CBE Life Sciences Education*, 9(1), 34–44. doi: 10.1187/cbe.09-07-0047.
- Lawson, A. E., Banks, D. L., & Logvin, M. (2007). Self-efficacy, reasoning ability, and achievement in college biology. *Journal of Research in Science Teaching*, 44(5), 706–724. doi: 10.1002/tea.20172

- National Policy on Education 6th edition [FRN]. (2014). Lagos, Nigeria, NERDC press.
- Novak, J. D. (1990). Concept mapping: A useful tool for science education. *Journal for Research in Science Teaching*, 27(10), 937–950. doi: 10.1002/tea.3660271003
- Odom, A. L., & Barrow, L. H. (1995). Development and application of a two-tier diagnostic test measuring college biology students' understanding of diffusion and osmosis after a course of instruction. *Journal of Research in Science Teaching*, 32(1), 45–61. doi: 10.1002/tea.3660320106
- Odom, A. L., & Barrow, L. H. (2007). High school biology students' knowledge and certainty about diffusion and osmosis concepts. *School Science and Mathematics*, 107(3), 94–101. doi: 10.1111/j.1949-8594.2007.tb17775.x
- Ogundiwin, O. A., & Oladipo, A. J. (2018). Effects of puzzle-based strategy on senior secondary school students' science process skill in biology in Oyo State. *Journal of Curriculum and Instruction*, 11(1), 26–36.
- Okoli J. N. (2009). Enhancing gender equity in entrepreneurship education through science and technology education in tertiary institution in Nigeria. In C. Nnaka & Z. Njoku (Eds.), *Ramifications in gender and STM education*.
- Oladipo, A. J. (2009). *Enhancing senior secondary school students' cognitive achievement in selected biology concepts using Mercedes model with embedded assessment strategy*. (Unpublished Ph.D. thesis). University of Lagos, Nigeria.
- Oladipo, A. J., & Ihemedu, C. M. (2016). Conceptual understanding of diffusion and osmosis among senior secondary school students in Lagos state. *Journal of Science Teachers' Association of Nigeria*, 53(1), 1–13.
- Oztas, F. (2014). How do high school students know diffusion and osmosis? High school students' difficulties in understanding diffusion and osmosis. *Procedia - Social and Behavioral Sciences*, 116, 3679–3682. doi: 10.1016/j.sbspro.2014.01.822
- Oztas, F., & Oztas, H. (2012). Biology teacher candidates' alternative conceptions about the human respiration and source of metabolic energy. *Energy Education Science and Technology Part B-Social and Educational Studies*, 4(2), 749–756.
- Rathgeber, E. M. (2009). *Women and girls in science and technology: Increasing opportunities in education, research and empowerment*. New York: United Nations Division for Advancement of Women.
- Sadler, P. M., & Sonnert, G. (2016). Understanding misconceptions: Teaching and learning in middle school physical science. *American Educator*, 40(1), 26–32.
- She, H-C. (2004). Facilitating changes in ninth grade students' understanding of dissolution and diffusion through DSLM instruction. *Research in Science Education*, 34(4), 503–525.
- Sundberg, M. D., Dini, M. L., & Li, E. (1994). Decreasing course content improves student comprehension of science and attitudes towards science in freshman biology. *Journal Research in Science Teaching*, 31(6), 679–693. doi: 10.1002/tea.3660310608

Udeani, U. (2010). Assessing the level of science process skills acquisition of Nigerian senior secondary school students in Lagos state. *African Journal of Curriculum and Instruction*, 1(1), 210–218.

UNESCO (2010). Women's and girls' access to and participation in science and technology careers: Paris, France: UNESCO 2.

WAEC Chief Examiners' Reports. (2000, 2003, 2005, 2006, 2012). *The West African Senior School Certificate Examination May/June: Chief Examiners Reports*. Nigeria, Yaba, Lagos.

Zuckerman, J.T. (1998). Representations of an osmosis problem. *American Biology Teacher*, 60(1), 27–30. doi: 10.2307/4450407

Authors

Dr. **Adenike Julianah Oladipo** is a science education facilitator and e-tutor in the Distance Learning Institute, University of Lagos. Her areas of research interest are in the teaching and learning of science in secondary schools with special interest in developing models for teaching for understanding and application of science concepts.

Dr. **Modupe Osokoya** is a Reader (Associate Professor) at the Institute of Education, University of Ibadan, Ibadan Nigeria. Her research studies centered primarily on students' achievement in science subjects generally at all levels.

Prof. **Uchenna Udeani** is a professor of science education and currently the director of Distance Learning Institute, University of Lagos, Nigeria. Her areas of research interest are in the teaching and learning of science in secondary schools with extended interest in the underrepresentation of girls in science and technology.

EXPERIMENTAL STUDIES OF THE AFFORDANCES OF
ASSISTIVE MULTIMODAL LEARNING DESIGNS:
UNIVERSAL DESIGN FOR LEARNING IN MODERN LANGUAGE CLASSROOMS

Henrik Kasch
Aarhus University, Denmark

Abstract: *This paper presents the data from two empirical studies of the learning affordances of a novel sui-generis language learning material, whose design is guided by universal design for learning (UDL) principles. Excepting a pilot study, the two studies appear to be the first outside the US to explore UDL principles and technology integration in language classrooms. The author conducted 9 + 14 interviews of stratified respondents from experimental studies in two year-seven language classrooms after a series of three interventions. In the interventions, three ebook prototypes with UDL-guided digital scaffolds were used in regular teaching, collaboratively planned, implemented, and evaluated by the teacher in question and the author. The paper in part supports earlier findings from previous UDL empirical studies in language learning but elaborates individual learners' learning experiences interacting with individual scaffolds, studying how lexical acquisition and competence and self-regulated learning can be scaffolded in a componential UDL design.*

Keywords: universal design for learning [UDL], experimental study, language acquisition, language teaching, multimodal

Introduction

The teaching of English literacy is important for educators across the globe. Of modern languages, English has become the language of science and professional international communication (Crystal, 2003; Pandarangga, 2016) but also a preferred lingua franca in online social media. English is taught as a compulsory subject in 86 percent of the countries of the world (Crystal, 2003; Pandarangga, 2016), and increasingly, countries outside the English-as-a-native-language (ENL) inner circle expect applicants to have communication skills in English (Pandarangga, 2016). For a long time, English has been considered a global language and a leading lingua franca (Crystal, 2003). Unsurprisingly, research has identified adverse educative Matthew effects of accumulated (dis-)advantage regarding English literacy (Ari, 2013; Lamb, 2011)

both in English as a second language (ESL) learners and English as a foreign language (EFL) learners. Global trade and industries call for the acquiring the four c's—critical thinking, creativity, collaboration, communication—of the 21st century skills, stipulating (international) digital literacy and collaboration skills, which are intrinsically linked with English proficiency.

Lexical competence is closely linked to (reading) literacy (Hsueh-Chao & Nation, 2000; Laufer & Ravenhorst-Kalovski, 2010; Rosado & Caro, 2018). Therefore, it is relevant to examine how digital scaffolds can be used in vocabulary acquisition. Without sight words—words immediately recognised by the reader—reading fluency is compromised. Moreover, struggling readers tend to use a bottom-up reading strategy, which is prone to affect global reading comprehension negatively (Laufer &

Ravenhorst-Kalovski, 2010). This strategy may obviously compound self-regulated learning processes as frustration or learned helplessness. Unsurprisingly, empirical studies in self-regulated learning also ascertain that “students need to have both the will and the skill” (Pintrich & De Groot, 1990, p. 37).

Aims and Contents

This paper aims to investigate how a UDL-guided instructional design for reading may increase engagement and foreign language learning by investigating the learners’ functionality usage and learning afforded by multimodal scaffolds removing recognition networks barriers. The paper begins by providing an empirical and theoretical background and then presents the design of the instructional material, then the method followed by the analysis of interview data and a subsequent discussion and conclusion.

Theoretical and empirical background.

The present paper draws on UDL theory and practice, primarily addressing recognition networks and providing the learner with multiple means of representation (Center for Applied Special Technology [CAST], 2011; Kasch, 2018). “Providing multiple means of representation” is but one pillar of the socio-cognitive UDL framework for learning based on socio-cognitive neuro-didactic studies of the learning brain consisting of

- a. Recognition networks dealing with how to sense and assign meaning patterns to what we see and how to understand information, ideas and concepts.
- b. Strategic networks relating primarily to executive functions” and being specialized in generating and overseeing mental and motor patterns so as to plan, execute, and monitor actions and skills.
- c. Affective networks specialized in evaluating patterns and assigning them emotional significance, enabling the

learner to engage with tasks and learning with the world around us. (Hall, Meyer, & Rose, 2012, pp. 2–3)

All three overlapping networks represent learning-process areas. Universal design for learning is guided by the idea that all learners display dynamic diversity in each area, and the rationale is thus for instruction and instructional materials to respect diversity to give access to learners and activate their resources. Rather than just provide ad-hoc retrofit solutions to special needs, such as general-purpose digital assistive software packages for learners with dyslexia or other learning disabilities, remedial functionalities can be integrated in main-stream learning designs (Rose, 2007).

Reviews of foreign language literacy studies reveal that lexical competence has been found to be strongly linked with reading comprehension (Caro & Mendinueta, 2017; Rosado & Caro, 2018). Early studies into lexical competence addressed vocabulary breadth dimensions and reading comprehension. Hsueh-Chao and Nation (2000) found that adequate reading comprehension for all participants called for a lexical coverage of a statistically inferred 98 percent of textual lexis. However, these numbers for coverage were challenged in Laufer and Ravenhorst-Kalovski (2010). Moreover, Laufer and Aviad-Levitzky (2017) studied the validity of vocabulary multiple-choice word recognition test vs. recall test and found that recall tests had lower results than word recognition tests. Comprehension vocabulary was better detected with the word recognition test. As for teaching vocabulary, Laufer and Rozovski-Roitblat (2011) pointed out in their review of studies into incidental vocabulary acquisition vs. form-focused instruction:

it follows that vocabulary learning is determined by repeated encounters with

the words and by quality of attention that learners pay to them (or elaboration, or involvement) during a communicative or any other learning task. (p. 395)

Laufer (2003) found word-focused activities were significantly superior to mere incidental reading activities for vocabulary intake, which were corroborated in a later study (Laufer & Rozovski-Roitblat, 2011). Additionally, ELLs in 4th-grade in a UDL classroom manifested second-language lexical competence gains as well as comprehension gains when reading lessons were paired with text-to-speech vocabulary and strategy supports (Proctor, Dalton, & Grisham, 2007).

Engagement has been studied extensively in the literature on self-efficacy deriving from the agentic positive psychology of Bandura (1994, 2007). Studies of motivational and self-regulated learning components of classroom academic performance found a positive correlation between self-efficacy, intrinsic motivation, and academic

performance (Pintrich & DeGroot, 1990). Because scaffolding has been found to aid task-persistence, it is relevant to examine whether learners' interaction with the scaffolds exhibit self-regulation and task-persistence (Wood, Bruner, & Ross, 1976).

Description of the Functionalities of the Instructional Design

The author constructed the instructional material using cast.org's bookbuilder e-book platform (see Figure 1). The platform features a built-in text-to-speech and highlighting functionality and an editable glossary interface that affords hyperlinked multimodal glossing. The author digitised and augmented an existing EFL learning material for Danish year-seven classrooms to feature a compendious bilingual multimodal glossary (text, sound, and image) and a bilingual retelling functionality representing paragraph contents and response field with a reflection question.

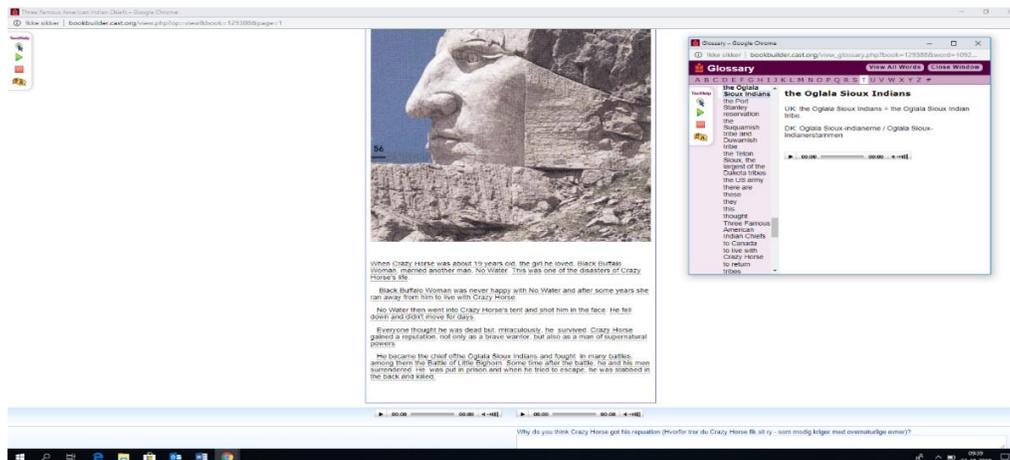


Figure 1. Screenshot of e-book designed by the author. It has nine scaffolding functionalities comprising of (a) compendious textual glossing in English, (b) compendious textual glossing in Danish, (c) pictorial glossing (see Kasch (2018) for multimodal semiotic and multimodality theories underlying multimodal glossing design), (d) compendious English audio glossing, (e) compendious Danish audio glossing, (f) retelling in Danish, (g) retelling in English, (h) text-to-speech with highlighting, and (i) a response field with a reflection question.

Method

Two qualitative studies of three interventions were conducted in two Danish public schools over four months and sought to have a representative breadth of learners and explore the learners' individual experiences learning English with access to comprehensive digital scaffolds. The learner diversity in the first study (Protocol 1) comprised four points out of a five-point range of proficiency levels scored at the Danish national English proficiency test (i.e. the strata clearly below average, below average, average, and above average) were all represented in the interview round of Protocol 1. As no clearly-below-average performers consented to being interviewed in the second study, Protocol 2 featured average and below-average, and above-average interviewees. No clearly above average performer was found in the two classrooms studied. Planning and running lessons were a collaborative effort by the participant teacher and researcher in search of ecological validity (i.e. applicability in real-world learning environment outside laboratories; see Brewer, 2000).

In strict conformity with Danish ethical standards, all interviewees were informed consenters as were participant schools. The first school was in a socio-economically middle-income municipality district but as can be seen from the sampling of learners in the classroom at hand performing a little below the national average. The second study was carried out in another municipality with a somewhat lower socio-economic base, but on average performing very well given the socio-economic variables though not for the intervention classroom at hand, which featured four times the national average of clearly-below-average performers and no clearly-above-average performers. In every intervention, reading activities led up to an

oral communicative task. Field notes, recorded meetings, and lessons were shared with the individual teacher participating to give their points of view.

The author conducted semi-structured interviews with 23 student respondents translating research questions into interview guide questions into everyday language (Brinkmann & Kvale, 2015; Kvale, 1983). The author asked students if and how they used digital functionalities and how they felt (if they did use them) the functionalities helping them to learn English. Conducting interviews, the author used screen dumps of the functionalities to aid subjects' recall of these when asking them about their learning experience regarding the function at hand. In general, the interview design asked respondents to give further experiences, comments, and viewpoints, if any. The author used humour and tried to his best to have a relaxed atmosphere when conducting interviews. Learners generally succeeded in conveying their learner behaviour, providing interesting data about both self-regulated learning and language learning associated with the use of the scaffold in question and the intensity/quality of the usage.

The author transcribed the interviews aiming at verbatim standards, annotating paralinguistic features (e.g. laughter and emphases), and attendant situational circumstances when needed for comprehension. Then the interviews were iteratively coded for usages with respect to use vs. no use of functionality to investigate usage variety in interviews. Initial analyses queried into reading comprehension and engagement in general, which were coded and later on confronted with self-regulation theory and studies (Usher & Pajares, 2008) as well as self-regulated learning studies including intrinsic motivation (Pintrich & De Groot, 1990) and flow (Csikszentmihalyi,

2014) for reiterated scrutiny and coding. Soon it became apparent that engagement, apart from being scaffolded by functionalities, involved both receptive and productive lexical competence. Confronting the data with lexical competence theories (Laufer, 2003, 2014; Rosado & Caro, 2018; Stæhr, 2009, 2015) and reading studies, the author inspired by Laufer (2003) and Laufer and Ravenhorst-Kalovski (2010) investigated learners' engagement in excess of mere reading by examining their reading-plus behaviour. In analysing and categorising reading-plus behaviours, new coding was introduced drawing on theories of attention in language learning (i.e. noticing theory; Schmidt, 2010; and pushed output; Canale & Swain, 1980) to account for usage behaviours. Also striking was the use of multimodal access to meaning content, which lead the author to study literature on multimodal sensory integration, ideas of multimodal integration, and learned super-additive effects, which manifested in interviews reflecting further reading-plus categories (Cheetham, 2019; Stephens & Kaiser, 2018). This line of inquiry called for yet another iteration of coding to examine how multimodal reading integration was perceived to affect reading comprehension in the interviewee responses.

The author used thematic meaning-condensation analysis of the interviews (Brinkman & Kvale, 2015; Kvale 1983, 1998) and found a variability of functionality affordances defined by Gibson (1986) as "...properties taken with reference to the observer..." being "...neither physical nor phenomenal" (p. 146) and what "an environment offers" (p. 127). Analogously, digital environments see affordances as what functionalities can be used and are used for by learners/users in human-device interaction (Beatty, 2013).

Thematic Analysis: Affordances and Experiences

The 23 interviews furnished the interviewer with a window on affordances in EFL learning as experienced by the diversity of learners in their classroom use of multimodal scaffolds. The analysis starts with examining reading task engagement.

Reading Task Engagement: Self-efficacy and Self-regulation

A recurrent theme in both protocols was how task-persistence—the student's management and control of their effort—was aided by the assistive functionalities. This finding seems remarkable as neither affective networks nor strategic networks played a prominent part in the scaffolds design and hence not the UDL model's cognitive components directly associated with self-regulation and self-regulated learning.

How comprehension scaffolds assist engagement and intrinsic motivation is illustrated in the excerpt from the interview of a clearly-below-average interviewee's account (Protocol 1, interview 1):

KUM: Yes, to comprehend things. If you can't comprehend things up here (pointing at a page of the ebook), then you can go here (pointing at the re-telling function icons).

I: So, you started reading here?

KUM: yes.

I: That is reading the text and then going down here and say okay I am not sure I understood this and then you could ...

KUM: (interrupting) yes.

I: hear things in English or in Danish.

KUM: Exactly!

I: And you used ... both of them, or?

KUM: Yes. First, I heard things in English and then in Danish afterwards.

Here KUM told the interviewer how they can use functionalities for textual comprehension and that with access to re-telling functions in English and Danish, they can persist in the task even when failing to comprehend the text at hand. Immediately before, KUM spoke of how good it was to have assistive functionalities in general and that they used all of them. Assistive scaffolds here aided task-persistence in reducing barriers to learning (reading comprehension) and possibly alleviating degrees of learned helplessness, but the resources lead to doing more than just reading—listening to both further English input and Danish re-telling. Both comprehension gains and further input, that is further work on the lexis and domain at hand, were afforded by multiple means of representation.

Learners from all performance strata liked to have a plethora of functionalities at their disposal, even above-average learners, as expressed by OM3 (Protocol 1, 7):

I: ... Was it nice to have all the (assistive) functions?

OM3: Yes.

I: Yes.

OM3: Then you can always, you know – then you know you can always make it (work)—that one can always get help from it—on the individual words.

I: Yes.

OM3: You are never stuck.

I: Yes.

OM3: which is delightful. (Parenthetical words added for comprehension.)

OM3's delight, indicative of intrinsic motivation at having the scaffolds (assistive functions) at their disposal aiding a smooth learning process is also attributable to the non-lemma glossing design.

OM3: Then I would not have to look up words in dictionaries, so it was rather easy to deal with.

I: Yes. Do you think—did it help you? How did it help you to learn English?

OM3: With respect to some words, which at Ordbogen.com (an online bilingual dictionary used in the classroom) can be hard to use because...

I: Yes.

OM3: They (the words) are divided into different syllables—or (found in) inflected forms...

I: Yes.

OM3: then I just went to the form it (the word) was in (the text).

I: because I have, I have, it is not just a base form.

OM3: Yes

I: I just take the form...

OM3: exactly...

I: that it is in.

OM3: and that was rather delightful. (Parenthetical words added for comprehension.)

Direct access to glosses appears to be a removal of lemma glossing-related barriers to learning seen to impede OM3's reading process. In other words, the learner's delight and intrinsic motivation seem to reflect aided self-regulation and the pleasure of task-persistence and flow.

A few learners used to the response field for the intended strategic use (self-regulated learning), as found in OM1's response (Protocol 2, 1):

I: Yes. How do you think it (the response field) helped you to learn English (laughing lightly)?

OM1: It um -

I: - if it did, you know?

OM1: Yes, but it helped in the way that you...you had to think back on what you had learnt...

I: Yes

OM1: and then you had to give an answer.

Here OM1 uses the response field for reflecting on their learning, as was the original purpose of this functionality, but the increased engagement of writing the answer also implies a reading-plus strategy.

Reading-plus Strategies: Receptive Lexical Competence

Vocabulary learning depends on “repeated encounters with the words” and “the quality of attention that learners pay to them (or elaboration, or involvement) during a communicative or any other learning task” (Laufer & Rozovski-Roitblat, 2011, p. 395). It is more than just reading the text once.

Some learners used the text-to-speech functionality (TTS) with highlighting to have bimodal access to comprehending lexis, which research into multisensory integration and language learning point to as having what Cheetham (2019) calls a super-additive effect. In the clearly-below-average learner KUM’s learning process (Protocol 1, 1) the strategy seemed to lead to intrinsic motivation and aided self-efficacy. The scaffolds enabled them to form positive expectancies of their ability to perform their reading task and extended their engagement into a reading-plus strategy. Providing multiple means of representation, thus meant providing multiple means of input. In this way, the original assistive functionalities afford inclusive practice and the help for struggling learners like KUM. KUM said it was a little “strange to use functionalities” at the beginning, but then “it became alright”, suggesting that they had not had access to such functionalities before, which may be why they emphasised how good it was for them to have multiple input access.

Average learners used multimodal input as well, using a combination of text-to-speech and retelling functionalities for aiding

reading comprehension. M2 responded (Protocol 1, 4):

I: ... Yes, there was this TTS function with which you could highlight some of the text, and then there was yellow highlighting and blue highlighting telling you how far you had made it into the text. Did you use that for anything?

M2: I did every time I read the text.

I: What did you use it for?

M2: to um get a – to understand things better –um – a little more precisely (than) if I was reading things myself.

It may seem odd that an average learner like M2, who was not a struggling reader, had just expressed that they did not need the sound gloss but used a remedial TTS function to heighten their reading comprehension. Super-additive effects and comprehension gains in multimodal access seemed to be manifested by M2. Another average learner (Protocol 2, 14) found another affordance in the TTS functionality—hypothesis-testing:

I: Did you use the text-to-speech function? The one where you highlight ...?

M4: No. no. I couldn’t ... I used it for a few words

I: yes

M4: If you were thinking, “What kind of words are they?”

I: Yes.

M4: And then I had it read aloud and then one would think: now I know what it, it made sense, if you didn’t quite ...

I: So, you used text-to-speech to make sure it was indeed the word that you thought it was?

M4: Yes, you know what it’s like.

Here, the TTS function apparently enables testing a lexical hypothesis and activating partial receptive lexical knowledge (Henriksen, 1999). Haastrup’s (1991) ideas of lexical-inferencing and long-term memory

retention gains come to mind, but these have been rejected by Laufer (2003). However, M4's lexical inferencing is followed by a further bimodal hypothesis-testing comparing sound and spelling. This learner strategy elaborates and strengthens lexical competence paving the way (in part at least) for long-term memory storage. The additional cues in the aural input seem to involve multisensory integration of multimodal inputs with the perceived comprehension gains reported supplementing the learner's partial unimodal lexical comprehension. Moreover, the TTS function was used to heighten attention or for noticing and further or deeper processing resulting in a reading-plus strategy.

Around half of the learners experienced comprehension gains from pictorial glossing, as expressed by the average learner M3 (Protocol 2, 12):

M3: I cannot remember which words it was exactly

I: No. It does not matter anyhow.

M3: yes.

I: Because what I want to ask you – that is – um, did you use the picture?

M3: It helped, you know. I looked at the text and then I saw the picture, and then I felt absolutely sure.

This average learner gives us clues how modality overlap aids comprehension and self-regulation, M3 apparently using pictorial input as feedback to test a hypothesis on lexical meaning, which when confirmed removes a possible comprehension barrier so that the learner can continue their reading process. An above-average learner from the first study, OM5 (Protocol 1, 7), even reported that they used the pictorial glossing first when consulting the glossary:

I: Um – did you use the picture?

OM5. Yes kind of. I looked a little at the picture...

I: yes.

OM5: because then you know what you are dealing with kind of, if it is something completely different or...

I: yes

OM5: s-something. And then I read the text afterwards.

The related experience presents a reversal of M3's learning path. Here, pictorial glossing helped the learner form a general impression of their lexical inferencing and then textual explanations are consulted for elaboration. As OM5 explained,

I: So, so, you read perhaps ... what-what, how, how did you read?

OM5: I read this (pointing at the gloss in English in a screen dump) for starters

I: in English, yes

OM5: and if I did not understand it, then I just read, then I just read the Danish one (gloss in Danish)

I: The Danish one, yes. Okay, so...

OM5: Then I also listened a little to this (sound gloss)

I: This you also used, what it is now, the sound, sound ...

OM5: yes.

In this excerpt, OM5 explained how they used the glossary, looking at the picture then the gloss in English, then the one in Danish, and then sometimes even the bilingual sound gloss, which they liked to (apparently out of intrinsic motivation) listen to because it was "a nice recital", as they "knew how to read it (the gloss)". Pictorial glossing here opens a trimodal reading-plus strategy, supporting both the learner comprehension and learning gains from super-additive effects, thus, strengthening intrinsic motivation and self-efficacy.

Reading-plus Strategies: Productive Lexical Competence

The functionalities also offered affordances for working with productive lexical competence. Thus, TTS bimodal input presented apparently still other affordances as found in this conversation from Protocol 1, 7:

I: ... Do you remember that there was this built-in text-to-speech function highlighting text in yellow and highlighting the word and highlighting in blue the word ...that it had just reached? Did you use that one?

OM2: Yes, I used that one, there was a time, though, when I had forgotten my earphones, but then I read instead.

I: Yes. But if you had brought your earphones, did you use it then?

OM2: Yes.

I: What did you use it for?

OM2: Um, I used it you know for kind of listening to – if there was a word I did not know how to pronounce...

I: yes

OM2: Then it pronounced it for me

I: yes

OM2: And then it was like, you know: well, okay the pronunciation is just like that.

For this above-average learner, the TTS functionality afforded a bimodal input useful for augmenting partial lexical knowledge and getting the pronunciation right as the learner said when asked to clarify how it helped to learn English. Such an affordance was also expressed by an average learner and a below-average learner, who also expressed that they used the functionality for working on pronunciation, of which UM2 (a below-average learner) in Protocol 2, 9:

UM2: And then I listened to the text, you know, later on to – hear how the words...

I: yes

UM2: were to be pronounced.

I: yes. So, you used it – okay – to get better at knowing how to pronounce it (the words)

UM: mm (confirming)

I: but maybe also to pronounce – did you practice the pronunciation of it?

UM2: Yes. (parentheses added to original transcription for comprehension)

Here, we see how receptive practice may be used together with productive reading practice but an aware attempt at a gap noticed in one's lexical competence, and thus facilitating phonological pushed output.

Further in a couple of cases, the response field, originally meant to scaffold task-persistence and executive functions, also lent itself to working on productive lexical competence expressed by OM2 (Protocol 1, 6):

I: What did you use it (the response field) for?

OM2: I just wrote what it was I was told to write; if a question was posed on for example what I thought witches were.

I: Yes

OM2: but then I wrote what I thought it was.

I: Okay. How um – how does it help you to learn English – Does it help?

OM2: Yes, you get to, you know, think about how I can put this (in English).

Here the learner appeared to use to the response field for working on output, or how to express something in English.

In OM3's responses, productive lexical practice appears to work in with elaboration (receptive skills):

I: Okay. Yes. Then there was this response field (pointing at functionality), which ...?

OM3: It was alright – then you got to – then you had a chance to elaborate a little...

I: Yes

OM3: after you had read the text...

I: Yes

OM3: And if you had not understood things, then you had to, you know, read things again so that you could answer the question and such. I thought it was nice that it was there.

Furthermore, self-regulated learning scaffolding is suggested, in the excerpt “then you had to, you know, read things again, so that you could answer the question”.

Misaffordances and Overall Functionality Usage

Some learners, however, expressed suspicion of misaffordances of the remedial learning design, especially when asked if they thought it a good idea to have all such assistive functionalities in general. This idea is exemplified by the average-learner M1 (Protocol 1, 3):

M1: Yes, but there must not be too much of it. There shouldn't be too much help because then we don't learn things by ourselves.

I: So, you think that then you would just use the Danish one (retelling in Danish functionality)?

M1: yes, yes.

Later on, when asked to clarify, it turned out that their apprehension concerned reading tasks not involving speaking or writing in English, though. A misapprehension similar was formulated by another average learner (Protocol 2, 13):

M3: What I was thinking was that it would just be the easy way; then you

might as well just stop reading it and listen to it and so on. Then you have sort of understood things in Danish, and then THAT is what you remember instead. I don't know if a lot would do that – to get it read aloud in English or something – and then just listen to it in Danish and then – just like being given a story in Danish.

Here M3 fears that people might be tempted just to have the passage retold and also feared that even an input in English would impede learning because people would not read the text and just remember the aural input, in general expressing that the access to scaffolds made things too easy. It is remarkable, though, M3 themselves reported preference for using retelling in English for comprehension gains, only using retelling in Danish once when struggling with a particular text, thus, used scaffolds as intended and engaged in an reading-plus learning behaviour.

Even so, all learners tended to engage in viable reading practices that would go beyond mere reading comprehension. Thus, interview data coding learning-relevant use only saw two learners not using (one possible below-average “outlier”—the only informant only appearing in the last intervention—and one above-average learner using only two) at least three functionalities, and four using less than four functionalities. This functionality usage is depicted in the boxplot below in which the lower whiskers (minimum values) of the respective strata below. (The singleton clearly-below-average learner has been lumped into the below-average stratum for ease of presentation). The box plot presents percentile-ordered data.

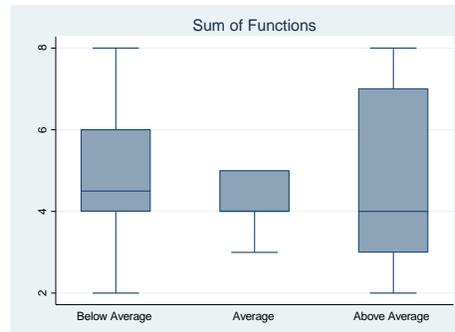


Figure 2. Box-plotted functionality usage in learner strata. The boxes account for 75 percent of each stratum, and here the respective strata represent functionality usage values between four and six for below-average learners, between four and five for average learners, and between three and seven for above average learners. In other words, multiple functionality usage - and hence enhanced engagement and lexical competence acquisition - seems to be the norm in the two-study sample, which is admittedly relatively small ($n = 23$), and hence, due caution should be taken.

Discussion

In general, the interview data seem to replicate findings from Proctor et al. (2007) and Strangman, Meyer, Hall, and Proctor (2014) with assistive technology like TTS being found to aid lexical competence in addition to reading comprehension. However, the novel affordances in design of compendious multimodal glossing and bilingual retelling functionalities scaffolded both executive functions and lexical competence acquisition. In other words, scaffolds helped learners self-regulate their learning processes and assistive functionalities and were put into meaningful vocabulary acquisition practice, including both usages foreseen and unforeseen. All respondents except one (a possible outlier) engaged in reading comprehension processes going beyond reading and incidental learning (Laufer, 2003). Learners' interaction patterns with the ebook prototype presented ways to pursue what may be considered reading-plus strategies stemming from a variability of affordances both scaffolding self-regulation, comprehension and lexical competence.

In general, interview data appear to support that the UDL-guided instructional material

design is conducive to language learning and comprehension, and that both glossing design and retelling sources as well as working on the response field assisting learners in self-regulating their learning. In addition to aiding comprehension, learner experiences present a wide variety of reading-plus interacting with the scaffolds (Laufer, 2003).

However, eight learners pointed to misaffordances or negative affordances imagined occasionally citing their own observations of other learners. In classical scaffolding theory and social constructivist learning practices, it is vital that the scaffolder facilitates the learner's learning process and does not prevent them or let themselves prevent themselves from taking the next step into their zone of proximal development (Vygotsky, 1978; Wood et al., 1976). Experienced ease of learning as associated with intrinsic motivation or self-efficacy could give rise to suspicion of misaffordances, namely, learners engaging in intrinsically motivating behaviour at the expense of learning engagement (Wood et al., 1976). Here scaffolding also called for the tutor to guide the learner to have a task focus and not engage in task-irrelevant activities. Therefore, when an above-average learner is

so delighted by the easy access to lexical meaning, it could be speculated that a higher intake could have evolved from forcing the learner out of (overly) smooth learning flow. On the other hand, according to flow theory, too low learning demands are associated with boredom rather than delight (Csikszentmihalyi, 2014). When the self-same learner expressed avoiding using the retelling functionality in Danish, as it would make learning “too easy”, the autotelic behaviour of the learner seemed to reflect a sound task engagement rather than counterproductive, self-regulated learning. Far more serious were the misaffordances owing to regular inexpediencies in the design found in the experiences of two learners—one with dyslexia finding the dotted-line interface a visual impediment and one with (self-expressed) OCD-like behaviour finding contiguous glossing hard to use when they only wanted one word. Although such inexpediencies did not compromise learning flow in general in the cases cited, self-regulation is at risk of being discontinued owing to (intrinsic) demotivation and negative self-efficacy.

The study used a sample of consenting interviewees, which may lead to biased answers. An aggregate sample of 23 respondents with verbatim-transcribed interviews amounting to approximately 140 pages may be fairly large for a qualitative study. In fact, functionality usage affordances explained found to be close to a point of saturation, with only a small deviation of explained experienced functionality usage found in the last series of interviews. However, different conditions in the two studies, with the latter study not being run contiguously may have led to less than optimal survey conditions (as does the

absence of clearly-above-average learners in the two samples). Moreover, the interviewer participated actively in classroom teaching, giving them access to an ecological learning environment, and personal relationships between interviewees and researcher may have influenced the way comments were made.

Conclusion

This paper examined the affordances of a componential UDL design used in a Danish EFL classroom. Remedial functionalities aided both self-regulation and viable lexical competence acquisition strategies. The viability and efficiency of the strategies were made plausible by accounts of the learners’ diverse interactions with functionalities, laying bare both self-regulation affordances like self-efficacy and intrinsic motivation as well as language learning affordances like multimodal super-additive effects leading to comprehension gains via multisensory integration, lexical inferencing with feedback, pronunciation practice, and phonological awareness. In this way, UDL-designs may help to reduce adverse Matthew effects and help educators promote plurilingual literacy in EFL learning environments across the globe. This seems to be the case if vocabulary learning is determined by repeated encounters with the words and by quality of attention that learners pay to them (or elaboration, or involvement) during a communicative or any other learning task (Laufer & Rozovski-Roitblat, 2011). A UDL design stimulates lexical competence acquisition for all learners by scaffolding the quality of attention, involvement, and elaboration in vocabulary learning across the language classroom.

References

- Ari, O. (2013). Matthew effects in struggling college readers. *Research & Teaching in Developmental Education, 30*(1), 4–22.
- Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71–81). New York: Academic Press.
- Bandura, A. (2007). An agentic perspective on positive psychology. In S. J. Lopez (Ed.). *Positive psychology: Expecting the best in people*, (Vol. 1, pp. 167–196). Westport, CT: Praeger.
- Beatty, K. (2013). *Teaching & researching: Computer-assisted language learning*. Philadelphia, PA: Routledge.
- Beveridge, S. (1998). Foreword. In C. Tilstone, L. Florian, & R. Rose (Eds.), *Promoting inclusive practice* (pp. i–xv). London: Routledge.
- Brewer, M. B. (2000). Research design and issues of validity. In *Handbook of research methods in social and personality psychology* (pp. 3–16). Cambridge, UK: Cambridge University Press.
- Brinkman, T., & Kvale, S. (2015). *InterViews. Learning the craft of qualitative research interviewing* (3rd ed.). London: Sage.
- Canale, M., & Swain, M. (1980). Theoretical bases of communicative approaches to second language teaching and testing. *Applied Linguistics, 1*(1), 1–47.
- Caro, K., & Mendinueta, N. R. (2017). Lexis, lexical competence and lexical knowledge: A review. *Journal of Language Teaching and Research, 8*(2), 205–213. doi: 10.17507/jltr.0802.01
- Center for Applied Special Technology [CAST]. (2011). *Universal design for learning guidelines, version 2.0*. Wakefield, MA: CAST. Retrieved from https://wvde.state.wv.us/osp/UDL/4_Guidelines_2.0.pdf
- Cheatham, D. (2019). Multi-modal language input: A learned superadditive effect. *Applied Linguistics Review, 10*(2), 179–200. doi: 10.1515/applirev-2017-0036
- Crystal, D. (2003). *English as a global language* (2nd ed.). Cambridge, UK: Cambridge University Press.
- Csikszentmihalyi, M. (2014). *Flow and the foundations of positive psychology: The collected works of Mihaly Csikszentmihalyi*. Heidelberg: Springer.
- Gibson, J. J. (1986). *The Ecological approach to visual perception*. New York: Taylor & Francis.
- Haastrup, K. (1991). *Lexical inferencing procedures or talking about words: Receptive procedures in foreign language learning with special reference to English*. Tübingen, Germany: Gunter Narr Verlag.
- Hall, T. E., Meyer, A., & Rose, D. H. (Eds.). (2012). *Universal design for learning in the classroom: Practical applications*. New York: Guilford.
- Henriksen, B. (1999). Three dimensions of vocabulary development. *Studies in Second Language Acquisition, 21*(2), 303–317. doi: 10.1017/s0272263199002089

- Hsueh-Chao, M. H., & Nation, P. (2000). Unknown vocabulary density and reading comprehension. *Reading in a Foreign Language*, 13(1), 403–431.
- Kasch, H. (2018). New multimodal designs for foreign language learning. *Learning Tech–Tidsskrift for læremidler, didaktik og teknologi*, 5(2018), 28–59. doi: 10.7146/lt.v4i5.111561
- Kvale, S. (1983). The qualitative research interview: A phenomenological and a hermeneutical mode of understanding. *Journal of Phenomenological Psychology*, 14(2), 171–196.
- Kvale, S. (1998). Analysemetoder. In *Interview - En Introduktion til det kvalitative forskningsinterview* (pp. 178–199).
- Lamb, M. (2011). A Matthew effect in English language education in a developing country context. In H. Coleman (Ed.), *Dreams and Realities: Developing Countries and the English Language* (pp. 186–206). London: The British Council.
- Laufer, B. (2003). Vocabulary acquisition in a second language: Do learners really acquire most vocabulary by reading? Some empirical evidence. *Canadian Modern Language Review*, 59(4), 567–587. doi: 10.3138/cmlr.59.4.567
- Laufer, B. (2014). Vocabulary in a second language: Selection, acquisition, and testing: A commentary on four studies for JALT vocabulary SIG. *Vocabulary Learning and Instruction*, 3(2), 38–46. doi: 10.7820/vli.v03.2.laufer
- Laufer, B., & Aviad-Levitzky, T. (2017). What type of vocabulary knowledge predicts reading comprehension: Word meaning recall or word meaning recognition? *Modern Language Journal*, 101(4), 729–741. doi: 10.1111/modl.12431
- Laufer, B., & Ravenhorst-Kalovski, G. C. (2010). Lexical threshold revisited: Lexical text coverage, learners' vocabulary size and reading comprehension. *Reading in a Foreign Language*, 22(1), 15–30.
- Laufer, B., & Rozovski-Roitblat, B. (2011). Incidental vocabulary acquisition: The effects of task type, word occurrence and their combination. *Language Teaching Research*, 15(4), 391–411. doi: 10.1177/1362168811412019
- Pandarangga, S. (2016). The transformation of English as a global language in the future. *LiNGUA*, 10(2), 90. doi: 10.18860/ling.v10i2.3132
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82(1), 33–40. doi: 10.1037/0022-0663.82.1.33
- Proctor, C. P., Dalton, B., & Grisham, D. L. (2007). Scaffolding English language learners and struggling readers in a universal literacy environment with embedded strategy instruction and vocabulary support. *Journal of Literacy Research*, 39(1), 71–93. doi: 10.1080/10862960709336758
- Rosado, N., & Caro, K. G. (2018). The relationship between lexis and reading comprehension. *English Language Teaching*, 11(11), 136–147. doi: 10.5539/elt.v11n11p136
- Rose, D. H. (2007). Universal design for learning and the future of education. *The 2007 Federation for*

Children with Special Needs' Visions of Community Conference.

- Schmidt, R. (2010). Attention, awareness, and individual differences in language learning. In W. M. Chan, S. Chi, K. N. Cin, J. Istanto, M. Nagami, J. W. Sew, T. Suthiwan, & I. Walker (eds.), *Proceedings of CLaSIC 2010*, Singapore, December 2-4 (pp. 721-737). Singapore: National University of Singapore, Centre for Language Studies.
- Stæhr, L. S. (2009). Vocabulary knowledge and advanced listening comprehension in English as a foreign language. *Studies in Second Language Acquisition*, 31(4), 577–607. doi: 10.1017/S0272263109990039
- Stæhr, L. S. (2015). Ordforrådstilegnelse - fundamentet for kommunikativ kompetence (transl: Vocabulary acquisition - The basis for communicative competence). In A. S. Gregersen (Ed.), *Sprogfag i forandring: pædagogik og praksis* (pp. 169–200). Copenhagen: Samfundslitteratur.
- Stephens, M., & Kaiser, M. R. (2018). A comparison of visual and audio scaffolds in L2 English reading. *Indonesian Journal of Applied Linguistics*, 8(2), 380–387. doi: 10.17509/ijal.v8i2.13303
- Strangman, N., Meyer, A., Hall, T., & Proctor, C. P. (2014). New technologies and universal design for learning in the foreign language classroom. In T. Barberi, E. C. Hamilton, & I. Sutherland (Eds.), *Worlds apart? Disability and foreign language learning* (pp. 164–176). Yale University Press. doi: 10.12987/yale/9780300116304.003.0009
- Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school : Critical review of the literature and future directions. *Review of Educational Research*, 78(4), 751–796. doi: 10.3102/0034654308321456
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, 17(2), 89–100. doi: 10.1111/j.1469-7610.1976.tb00381.x

Author

Henrik Kasch is a PhD fellow at the Danish School of Education, DPU, Aarhus University, Denmark. He lectures in language teaching and pedagogy. He is on leave from a position as associate professor at University College of South Denmark, Department of Teacher Education. His field of interest is in integrating universal design and computer-assisted language learning. He has published articles in his field of interest and co-authored and edited books on digital pedagogies in history and foreign language learning as well as a university textbook on English grammar with digital interactive assignments.

Publication Guidelines

The journal (*JISTE*) publishes articles by members of the International Society for Teacher Education (ISfTE). Exceptions are made for a non-member who is a co-author with a member, or who is invited to write for a special issue of the journal, or for other special/specific reasons.

- Articles submitted to *JISTE* must be written in English, following manuscript guidelines (see below) and will be anonymously reviewed by referees. Each article must pass the review process to be accepted for publication. The editors will notify the first author of the manuscript if it does not meet submission requirements.
- Articles are judged for (a) significance to the field of teacher education from a global perspective, (b) comprehensiveness of the literature review, (c) clarity of presentation, and (d) adequacy of evidence for conclusions. Research manuscripts are also evaluated for adequacy of the rationale and appropriateness of the design and analysis. Scholarly relevance is crucial. Be sure to evaluate your information. Articles should move beyond description to present inquiry, critical analysis, and provoke discussion.
- Articles pertaining to a specific country or world area should be authored by a teacher educator from that country or world area.
- All manuscripts accepted for publication will be edited to improve clarity, to conform to style, to correct grammar, and to fit available space. Submission of the article is considered permission to edit to article.
- The final decision to publish an article rests with the associate editor(s).
- Published manuscripts become the property of the *Society*. Permission to reproduce articles must be requested from the editors. The submission and subsequent acceptance of a manuscript for publication serves as the copyright waiver from the author(s).
- Writing and editorial style shall follow directions in the *Publication Manual of the American Psychological Association* (6th ed., 2009). References MUST follow the APA style manual. Information on the use of APA style may be obtained at www.apa.org.

Manuscript Guidelines

- Manuscript length, including all references, tables, charts, or figures, should be 3,000 to 5,000 words. Maximum length is 6,000 words. Shorter pieces of 1500-3,000 words, such as policy review or critique papers are welcomed.
- All text should be double-spaced with margins 1 inch (2.5 cm) all around and left justified only.
- Paragraphs should be indented using the “tab” key on the keyboard. No extra spacing should be between paragraphs.
- Tables, figures, and charts should be kept to a minimum (no more than 4 per article) and sized to fit between 5.5 x 8.5 inches or 14 x 20 cm.
- Abstract should be limited to 100-150 words.
- Include four or five keywords for database referencing; place immediately after the abstract.
- Cover page shall include the following information: Title of the manuscript; name(s) of author, institution(s), complete mailing address, email address, business and home (mobile) phone numbers, and fax number. Also, on the cover page, please include a brief biographical sketch, background, and areas of specialization for each author. Please do not exceed 30 words per author.

Book and Other Media Review Submission

Reviews of books or other educational media are welcome. Either the review or the item reviewed must be by a current member of ISfTE. Reviews must be no longer than 1000 words.

Annotation of Recent Publications by Members Submission

ISfTE members may submit an annotated reference to any book which they have published during the past three years. Annotation should be no longer than 150 words.

Submission Requirements

It is preferred that articles be submitted directly to the editor, Karen Bjerg Petersen at kp@edu.au.dk. To submit an article by email, send it as an attachment using MS Word, if at all possible.

Manuscripts and editorial correspondence should be directed to:

Dr. Karen Bjerg Petersen, Editor, *JISTE*
Jens Chr. Schousvej 4, Building 1483, room no. 551
8000 Aarhus C.
Danish School of Education, University of Aarhus Denmark
Email: kp@edu.au.dk

Book reviews should be directed to:

Dr. David Byrd or Dr. DeeDee Mower, Associate Editors, *JISTE*
Weber State University
1351 Edvalson St., Dept. 1304
Ogden, UT USA, 84408-1304
Email: davidbyrd@weber.edu; dmower@weber.edu

Future Issues and Submission Deadlines

2020 (Volume 24, Number 1)

Theme – *Teacher Education for the Next Decade: Looking to the Past to Inform the Future* is the theme chosen by the conveners of the 39th seminar for ISfTE held at Brock University, Niagara Falls, Canada, May 2019. For JISTE publication, participants must revise their seminar papers, attending carefully to the manuscript and publication guidelines, and submit them to the journal for consideration. Book reviews on the theme are also invited.

Submission deadline has passed – Publication by June/July 2020

2020 (Volume 24, Number 2)

Open issue. We invite members of ISfTE to submit articles for this issue. Members are encouraged to co-author articles with their students or colleagues who may not be members of ISfTE. Authors who are not members of ISfTE may submit articles for this open issue. In case their articles are accepted for publication, the authors must pay membership fee to ISfTE. Book reviews and reflection papers are also invited.

Deadline for submission: August 1, 2020 – Publication by December 2020

2021 (Volume 25, Number 1)

Theme – *Preparing Students for 21st Century Challenges through Improved Learning Outcomes* is the theme chosen by the conveners of the 40th seminar for ISfTE, which will be held at the Paro College of Education in Paro, Bhutan in June 2020. For JISTE publication, participants must revise their seminar papers, attending carefully to the manuscript and publication guidelines, and submit them to the journal for consideration. Book reviews on the theme are also invited.

Deadline for submission: November 1, 2020 – Publication by June/July 2021

Front Cover Information

These institutions' logos appear on the front cover of this issue: Joetsu University of Education, Japan. It sponsored the ISfTE seminar in 2018. The other institutions – University of Aarhus University, Denmark, Weber State University, USA, and Brock University, Canada – support JISTE with their on-going sponsorship and/or the support of the work of the editors and officials of ISFTE. If other institutions would like to help sponsor *JISTE*, please contact the journal's editor, Karen Berg Petersen.

About the Universities

Joetsu University of Education in Niigata, Japan, was founded in 1978. It provides undergraduate and graduate degrees in special education and specialized subject fields in education. It is well-known for its *Demonstration and Research Center for the Handicapped*.

Aarhus University is the second oldest university in Denmark. It is also the largest university in the country with over 43,000 students. It offers programmes in both undergraduate and graduate studies. Although the main campus is in the city of Aarhus, Denmark, the university has small campuses in Copenhagen and Herning.

Weber State University in Ogden, Utah, United States, was founded in 1889. It is a coeducational, publicly supported university offering professional, liberal arts, and technical certificates, as well as associate, bachelor's, and master's degrees. Currently, over 26,000 students attend the university.

Brock University is a public research university in St. Catharines, Ontario, Canada. Brock offers a wide range of programs at the undergraduate and graduate levels, including professional degrees. Brock was ranked third among Canadian universities in the undergraduate category for research publication output and impact indicators in 2008.