



Research paper

# Personalized learning: The simple, the complicated, the complex and the chaotic

Maya Gunawardena<sup>a,\*</sup>, Penny Bishop<sup>b</sup>, Kithmini Aviruppola<sup>a</sup>

<sup>a</sup> Faculty of Education, University of Canberra, Australia

<sup>b</sup> College of Education and Human Development, University of Maine, Orono, United States

## ARTICLE INFO

### Keywords:

Teachers  
Personalized learning  
Complexity theory  
Pedagogy

## ABSTRACT

Personalized learning is touted to provide opportunities for learners to achieve their full potential while developing a love of learning. However, questions regarding the practicality of implementing it remain. This qualitative case study inquired into the perspectives of Australian secondary school teachers who reported interest in implementing personalized learning. Using complexity theory, the researchers examined participants' perspectives and used NVivo to code data according to the classifications of simple, complicated, complex, and chaotic. Findings included teachers' enthusiasm and wariness. This study suggests that complexity theory helps navigating the issues to help teachers to evolve and sustain in managing the complexity.

## 1. Introduction

Across the globe, there is a growing awareness that a one-size-fits-all approach to schooling is insufficient to meet learners' needs or those of society at large. In response, nations including Australia (Gonski et al., 2018), Canada, Denmark, France, Germany, the United Kingdom (OECD, 2006), New Zealand (Tolmie, 2016), and the United States (Herold, 2017) increasingly have turned to personalized learning to meet the diverse array of students' needs in schools. Although definitions vary, personalized learning generally is viewed as an educational approach that customizes learning experiences to address each student's strengths, needs, skills, background, and interests (Bishop, Downes, & Farber, 2019).

While personalized learning has expanded considerably in the past two decades, the principles of personalization are centuries deep. Rousseau advocated in the 18th century for an education in which the learner was at the center. Dewey emphasized the importance of using a learner's prior knowledge as the basis for planning instruction (1902). Montessori asserted that effective learning necessitates uninterrupted time to master the material and a degree of choice to make learning relevant (1912). Bloom underscored the need for educators to find methods of group instruction that were as effective as one-to-one tutoring (1973; 1984).

With the turn of the century, the Organization for Economic

Cooperation and Development noted that personalization goes "well beyond the directions for school reform itself, as the personalization agenda is also about promoting lifelong learning and of reforming public services more broadly" (2006, p. 3), suggesting the potential for personalized learning to alter social and economic contexts. Indeed, more recently the United Nations Educational, Scientific and Cultural Organization (UNESCO) asserted that "access to quality education means access to personalized learning" (UNESCO, 2017, p. 57), highlighting the promise that the practice holds for addressing the uneven outcomes of schooling. As Groff stated, personalized learning is critical because it "fully aligns with the learning sciences. More than a century since Dewey's ideas hit print, we might ask how these visions can be actualized in our current world. How do we create personalized, learner-constructed experiences at scale, in schools, and beyond? (2017, p. 1). Because definitions and implementation models of personalized learning vary widely (Zhang, Basham, & Yang, 2020a), those who wish to enact such change in schools would benefit from understanding how educators conceptualize this practice.

To that end, this study explored teachers' perceptions of personalized learning in one region where the practice has been identified as desirable: the Australian Capital Territory. In their Report of the Review to Achieve Educational Excellence in Australian Schools, Gonski et al. (2018) deemed personalized learning as foundational to achieving the goal of a minimum of "one year's growth in learning for every student

\* Corresponding author.

E-mail addresses: [Maya.Gunawardena@canberra.edu.au](mailto:Maya.Gunawardena@canberra.edu.au) (M. Gunawardena), [penny.bishop@maine.edu](mailto:penny.bishop@maine.edu) (P. Bishop), [Kithmini.Aviruppola@canberra.edu.au](mailto:Kithmini.Aviruppola@canberra.edu.au) (K. Aviruppola).

<https://doi.org/10.1016/j.tate.2023.104429>

Received 31 March 2023; Received in revised form 3 October 2023; Accepted 29 November 2023

Available online 17 December 2023

0742-051X/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

every year” (p. 12). They asserted, “learning and teaching—based on each child’s learning needs and informed by an iterative evaluation of the impact of those strategies— are effective at improving education outcomes for all students” (p. 10). The Australian Capital Territory’s (ACT) ten-year education strategy proclaimed that its future education system “will be personalized to each child. It will celebrate the differences that affect needs, abilities, motivations, interests and aspirations” (ACT Government: *The Future of Education* (2018)).

As in other nations, personalized learning in Australia has been met with public criticism as opponents have decried the possibility of adopting such measures, despite the political motivations (Allen, Rowan, & Singh, 2018). Some have criticized personalized learning as fuzzy and ideological (Needham, 2011; Pykett, 2009) and others have deemed it too difficult to enact within the context of a prescriptive curriculum (Campbell, Robinson, Neelands, Hewston, & Mazzoli, 2007). Given that limited research exists on personalization within an Australian educational context (Prain et al., 2013) and that the practice remains ill-defined in the research literature (Waldrip, Yu, & Prain, 2016; Zhang, Basham, & Yang, 2020a), it is perhaps understandable that the practice is not more widespread in the country.

Although educators are key to the effective enactment of pedagogical change (Zhang, Basham, & Yang, 2020a), teachers in Australia have received little guidance, structure, or support for the implementation of personalized learning (Prain et al., 2013; Stewart, 2017). With the practice’s prioritization in national and regional policy frameworks, and also in future education strategic plans such as the Australian Capital Territory’s future Education Strategy for the next ten years (ACT Government: *The future of Education*, 2018), however, achieving the aforementioned goals for Australian learners will require understanding teachers’ conceptualization and practices of personalized learning.

To that end, this study investigated teacher perspectives of personalized learning through the lens of the complexity theory (Morrison, 2002) by posing two research questions:

- (1) How do participating teachers conceptualize personalized learning?
- (2) What instructional approaches do they currently use to personalize instruction?

### 1.1. Personalized learning

Providing an adequate and holistic definition for personalized learning is challenging, as both interpretation and implementation have varied widely over time and context (Zhang, Basham, & Yang, 2020a). At the core of most definitions are two components: tailoring learning to each student’s strengths, needs, and interests; and providing students with choice, voice, and flexibility in reaching learning outcomes (Bishop et al., 2019; Jenkins & Keefe, 2002; Patrick, Worthen, Frost, & Gentz, 2016; Prain et al., 2013; Rubin & Sanford, 2021). In many ways, these elements of education reflect the principles of democratic schooling. Over a century ago, Dewey (1903) observed that “democracy means freeing intelligence for independent effectiveness—the emancipation of mind as an individual organ to do its own work” (p. 193). Without the freedom of intelligence, then, classrooms risk becoming undemocratic. Dewey argued that learners found “classroom conditions antagonistic or at least lacking” to the development of their full mental power (p. 193). Indeed, to remedy issues of boredom or lack of enthusiasm that many have noted in contemporary education, advocates of personalized learning have shown the importance of providing students with choice over the curricular content and learning processes, in contrast to educators teaching and telling them (Nagle & Bishop, 2021).

Increasingly, research has examined the everyday enactment of personalized learning. O’Donnell (2021) illustrated how teachers negotiate with students using a series of instructional procedures to move first from teacher-centered to student-centered, and then to more

student-driven learning through the flexible process of learning. They “engage in research, thoughtful discussions, courageous conversations, and carefully constructed writing processes, while also emphasizing curiosity, critical thinking, relationship development, and social activism” (O’Donnell, 2021, p. 1). Taylor and Hunt (2021) offered a model to help teachers structure flexible learning processes. Their Educate, Act, Connect, and Communicate model for personalized learning showed the integration of project-based learning and curricular goals into the process of learning. Taylor and Hunt asserted that teachers need “a framework for teaching and learning, one that outlines the structures, standards, and skills required of students” as a foundation for success in personalized learning (p.2). As personalized learning moves from theory to implementation, researchers are increasingly exploring its challenges and affordances. As with most educational initiatives, personalized learning requires unpacking and dispelling the myths around it is timely and important.

Numerous studies have reported the positive effects of personalized learning on student learning (Alamri, Lowell, Watson, & Watson, 2020; Basham, Hall, Carter, & Stahl, 2016; Duncan, 2013; Pane et al., 2015). For example, Pane et al. (2015) obtained achievement data from 62 schools implementing personalized learning over two years and compared them with more standard school groups. This study indicated that students who learned in personalized learning environments made considerable progress in comparison to their counterparts. Alamri et al.’s (2020) study compared the experience of graduate-level students in a one-size-fits-all course with those in a personalized learning course. This study revealed that the students who participated in the latter had positive perceptions overall and felt that the personalized learning design enhanced their sense of autonomy, competence, intrinsic motivation, and learning. These researchers also found that students who were enrolled in the more traditional course were generally dissatisfied with the course approach and how their interests and learning needs were met. Moreover, a study conducted by AndhariniDwi and Basuki (2012) on personalized learning in a web-based module concluded that the effectiveness and achievement of students were higher in the personalized learning mode compared with the non-personalized learning mode.

However, the results of such studies may not be definitive, as a range of variables impact the results, including the diverse instructional practices that are also adopted by teachers worldwide. Students’ prior knowledge (Chen, Huang, Shih, & Chang, 2016), availability of resources (Prain et al., 2013), technology-enhanced instruction (Li & Wong, 2021), and engagement level (Li & Wong, 2021) are also examples of variables that may affect outcomes. Additionally, personalized learning has been largely implemented in a context-dependent manner, so there is no uniform method of implementing personalized learning across all contexts (Dockerman, 2018). It is therefore equally challenging to determine how it should be implemented in each context.

For example, some studies (e.g., Major et al., 2021; Shemschack et al., 2021) have found that the successful implementation of personalized learning is dependent on the use of technology. In contrast, Basham et al. (2016) found that personalized learning environments require more than technology, and that technology is merely a tool for facilitating the implementation of personalized learning environments. These researchers believe that while personalized learning has the potential to revolutionize education, it will be haphazardly resisted, incompletely implemented, and eventually demonized as an unrealistic educational trend if there is no guidance or research-based understanding of it. We, therefore, chose to conduct this study using a complexity theory lens to unravel the teachers’ dilemma of implementing personalized learning. Future research is necessary to understand how teachers conceptualize it and their instructional strategies for enacting its core principles.

## 1.2. Complexity theory as a framework to understand personalized learning

Educational experts often formulate policies that address a single or relatively small set of problems and then implement them, believing (or at least hoping) the solution they advocate will be efficient, complete, widely scalable, comprehensive, and easily implemented (Snyder, 2013). Unfortunately, linear approaches are rarely sufficient to address complex issues (Duit, Galaz, Eckerberg, & Ebbesson, 2010; Mason, 2008; Morrison, 2010), as they are essentially incapable of generating viable solutions for a broader audience. In contrast, complex systems are characterized by “highly connected networks of semi-independent agents from which system-wide patterns emerge that can learn and adapt over time” (Davis, Dent, & Wharff, 2015, p. 334). This complexity does not imply negativity in its entirety; on the contrary, complexity can potentially bring about positive change (Turner & Baker, 2019; Zheng, 2013).

Personalized learning is one such complex entity, in that it involves a myriad of non-linear interactions, processes with recursive feedback loops, and multiple actors, making it unordered, complex, and often confusing for teachers, policymakers, and stakeholders, while also complicating research (Bernacki, Greene, & Lobczowski, 2021; Shemshack, Kinshuk, & Spector, 2021; Zhang, Basham, & Yang, 2020a). Attempts at educational reform should take into account education’s sprawling nature to avoid systemic paralysis, confusion, or an oversimplified and limited focus (Snyder, 2013). Indeed, understanding the complexity itself is thus essential for engaging in the complex realm successfully (Snyder 2013).

In this study, complexity theory served as a framework to identify “the simple (Known Knowns), the complicated (Known Unknowns) the complex (Unknown Unknowns), and the chaotic (Unknowables)” (Turner & Baker, 2019, p. 16) of personalized learning. As Snowden and Boone (2007) described:

“Simple and complicated contexts assume an ordered universe, where cause-and-effect relationships are perceptible, and right answers can be determined based on the facts. Complex and chaotic contexts are unordered—there is no immediately apparent relationship between cause and effect, and the way forward is determined based on emerging patterns” (p. 4)

Complexity theory positions personalized learning within the complex environment of rapidly advancing technology, globalization, cultural diversity, and a multitude of challenges and opportunities that lie ahead. Moreover, personalized learning has been implemented divergently across contexts. For example, in the USA in Vermont, teachers are required to apply three components to actualize personalized learning goals: personalized learning plans, flexible pathways, and proficiency-based assessment (Bishop et al., 2019). In Rhode Island, schools adopt a three-year inclusive transition to personalized learning by implementing a culturally responsive sustaining pedagogy framework by Ladson Billing and her team (Rubin & Sanford, 2021). On the other hand, a study in Kansas state about their school redesign shows that there is “little consensus about how best to implement learning” in the Kansas state (Zhang, Basham, & Yang, 2020a, p. 253). The above examples further affirm the complexity surrounding the construct, “its lack of conceptual coherence” (Prain et al., 2013, p. 654) and its practical divergence, nonlinearity, and uncertainties. Hence, the rejection, issues with teacher buy in and lack of guidance for teachers to implement it (Stewart, 2017) may be normal and teachers may fear the potential failures, frustrations, and disappointments. This study was an attempt to understand the entailing issues from teachers’ perspectives.

## 2. Research methods

To address our research questions, we employed a qualitative case study approach, in which we gathered data through semi-structured

interviews with secondary school teachers to better understand the current practices of personalized learning within their school context (Kvale, 1994). We chose a case study as our method because it is well suited to exploring and understanding a real-life issue that is influenced and affected by a wide range of contextual factors (Yin & Davis, 2007). This study represents a combination of intrinsic (providing insight into a specific issue) and instrumental (providing insight into other issues and processes) case study in that in addition to examining personalized learning, it provided insight into other related issues, which are more fully described below.

### 2.1. Research context and participants

The study was conducted with seven teachers who taught at a school (K-10) in the Australian Capital Territory (ACT). It is an International Baccalaureate (IB) school where teachers are required to integrate the IB Curriculum and assessment procedures in the implementation of the Australian Curriculum. The school was chosen because personalized learning was incorporated into its five-year strategic action plan and the research team was invited to work with the school as critical friends. The schoolteachers have not had any professional learning prior to this study and researchers aimed to understand the baseline data before an intervention was considered.

The school included students from a variety of linguistic backgrounds, as well as Aboriginal and/or Torres Strait Islander students. At the time of the study, approximately 34% of students in the school spoke a language other than English at home, and 5% identified as Aboriginal or Torres Strait Islander. This study received full approval from both the University’s Ethics Committee and the ACT Directorate of Education (9262). As an initial step for teacher professional development on personalized learning, the school leadership approved the study to occur in the school and teachers had the choice either to participate in the study or not. An email was sent to all teachers inviting their voluntary participation and consent, and all teachers who consented to the study were included. These seven teachers represented the teacher community in the school to learn, engage, and report to other teachers their professional learning communities regarding personalized learning. Four teachers identified as female and three as male, with their teaching experience ranging from five to twenty years and their highest educational qualifications ranging from bachelor’s to post-graduate degrees (see Table 1). Most had taught at other schools in the region before teaching in the school in which we conducted the research. Consequently, the teachers had a wide range of experience and perspectives to contribute, and they volunteered to co-collaborate with the researchers to explore opportunities for personalized learning and inform other teachers about their learning.

### 2.2. Data collection and analysis

We chose to use a semi-structured interview protocol to incorporate further questions based on the teachers’ responses, as well as to identify and pursue additional areas that could prove beneficial to the research project as a whole (Kvale, 1994). The interviews ranged from 30 to 40 min in length, and they were audio-recorded. The interviews were transcribed using ‘Descript’ software and all transcripts were reviewed alongside the recordings to ensure accuracy. We then conducted a thematic analysis (Braun & Clarke, 2006) of the data, reading and re-reading each transcript to gain a deeper understanding of the information contained within it. Next, we coded the data using NVIVO software, coding and assigning nodes and then tabulating all relevant data into an Excel spreadsheet.

We then developed themes (e.g., what is personalized learning; challenges to personalized learning; support needed for personalized learning) relevant to each code (Braun & Clarke, 2006). This process revealed how complex the conceptualization and implementation of personalized learning were among the participating teachers. It became

**Table 1**  
Definitions of personalized learning provided by teachers.

Participant	Definition	Common elements
Participant 01	' ... ....it's to find out what is the <b>student's interests</b> . And then, um, so you cater towards their <b>needs</b> , but also their <b>passion and interest</b> . I think they'll have more, take into the project you give them if they are <b>interested</b> in it'	Needs, strengths, interests, passions
Participant 02	' ... .... it means that a student has <b>different learning requirements</b> to most of the class so it's not quite scaffolding work. It's more like approaching work differently for that student based on their <b>learning needs</b> so that they can learn at the same <b>pace</b> in the same way as the rest of the class.	Different learning requirements, learning needs, pace
Participant 03	' I think it's getting like the kids <b>interested</b> in their own learnings, and making the connections with the kids, real life, you know, interests that they have, it's <b>differentiated</b> . So like all the kids can access the curriculum. hopefully, something that they're <b>passionate</b> about, or if it's not, if they're not passionate about it, you can make the <b>links to something that they're interested in</b> '	Differentiated interests, passion, linking to student interests
Participant 04	'“I think the personalized learning to me is, um, is making sure that students have what they need to grow and develop successfully. Like what people like <b>different people need different things to achieve success</b> ”	Differences, needs
Participant 05	'I sort of thought about personalized learning is something that. Um, is establishing, you know, <b>different learning goals</b> for different students based on their personality, their learning styles, you know, their current knowledge and skill levels in, in various subjects'	Differentiated learning goals, differentiated learning styles
Participant 06	'From my perspective is when it's just different from differentiation in that you actually have to, uh, <b>adjust the learning</b> to be more, um, specific to the needs of that student'	Needs, adjusting learning
Participant 07	' ... .... I feel personalized because the students have <b>individual needs</b> . So it is important that, um, and they learn in a <b>unique manner</b> . So each and every student, we have to cater to <b>their learning</b> and that is why I feel that personalized learning helps them, you know, grasp the concepts'	Needs, learning in unique manner

apparent that there were substantial similarities and conflicting viewpoints between and among participants. This pertained both to the conceptualization and the implementation of personalized learning. While teachers largely conceptualized personalized learning in similar ways, with their definitions sharing common characteristics, their perspectives about the implementation of personalized learning conflicted. The teachers generally understood personalized learning in theory but reported that they were unable to determine how or with whom to implement it. Consequently, we adopted Complexity Theory (Morrison, 2002; Turner & Baker, 2019) as a theoretical framework with which to further analyze the results of this study.

We classified the data from the NVivo coding into the simple (known knowns), the complicated (known unknowns), the complex (unknown unknowns), and the chaotic (unknowables) (Turner & Baker, 2019), as in Fig. 1. Data were categorized as “simple” if they contained a small number of variables or parameters, produced roughly uniform results, and followed a linear pattern (Snyder, 2013), meaning that participants'

answers to the question “what is learning” exhibited a similar pattern and understanding, and used unified terminology. In a simple context, cause equals effect, and it is a known territory; clearly identifying the appropriate responses is possible (Snyder, 2013). Accordingly, we classified the data into the simple realm based on the fact that the responses to the questions posed were similar and linear. The complicated realm, on the other hand, tends to exhibit known unknowns (Snyder, 2013), where an issue is recognized as being uncertain or incompletely understood. Hence, data categorized as “complicated” reflected participants' confusion, evidenced by their familiarity with the concept of personalized learning, but their skepticism about its application. In the complex realm, the unknown unknowns (Snyder, 2013) are aspects that are not recognized or understood completely, making it difficult to anticipate since they are not directly acknowledged and accounted for. Due to this lack of recognition or understanding, the complex realm makes it problematic to plan for the potential challenges ahead. Consequently, those data classified as “complex” were ones that participants expressed extreme concern about, as such issues had not previously been addressed, leading to complete unpredictability. For example, concerns related to how personalized learning addresses the key contents of a curriculum, or how it would be made appropriate for a large number of students with differing needs. Data were categorized into the complicated and the complex realms primarily based on the participants' familiarity with PL. Comments conveying skepticism toward its implementation fell into the complicated realm; participants that implied reluctance toward the implementation of personalized learning in their present educational setting were designated as complex. Finally, in the unknowable or chaotic realm (Snyder, 2013) one can try to drag the problem back into complexity by using direct command and control mechanisms to encourage divergent viewpoints (Snowden & Boone, 2007). In this study, chaotic situations were ones in which students displayed highly unpredictable and irregular behavior that was difficult for educators to predict and understand. This included students who were visibly disengaged from the course content and those who experienced other difficulties. While there were other themes, we focused on classifying the themes based on the four quadrants of the complexity theory.

### 3. Findings

This section is arranged according to the themes identified during the analysis of the study in accordance with Braun and Clarke (2006). Fig. 1 presents a sample of the findings in a graphical form as per the themes of complexity theory as represented in Turner and Baker (2019, p. 16).

#### 3.1. The simple

The participants' definitions of personalized learning were readily described and highly similar. They defined personalized learning as a means of customizing learning opportunities to individual student needs, strengths, passions, and interests. They all believed it was a useful way to address student diversity and equity. According to Complexity Theory, simple issues are situations that can be clearly defined, and the appropriate response can be determined (Snyder, 2013). In other words, it is what one is generally familiar with, where the cause equals effect. For example, Derrick, a year 10 teacher, explained that every student has different learning requirements and therefore it was essential to cater to each student based on their differences.” ... a student has different learning requirements to most of the class so it's not quite scaffolding work. It's more like approaching work differently for that student based on their learning needs”.

Derrick further elaborated on how learning needs should be designed differently based on students' needs:

“to sort of individualize the instruction based on the Australian Curriculum standards for that year group. And then modify it for

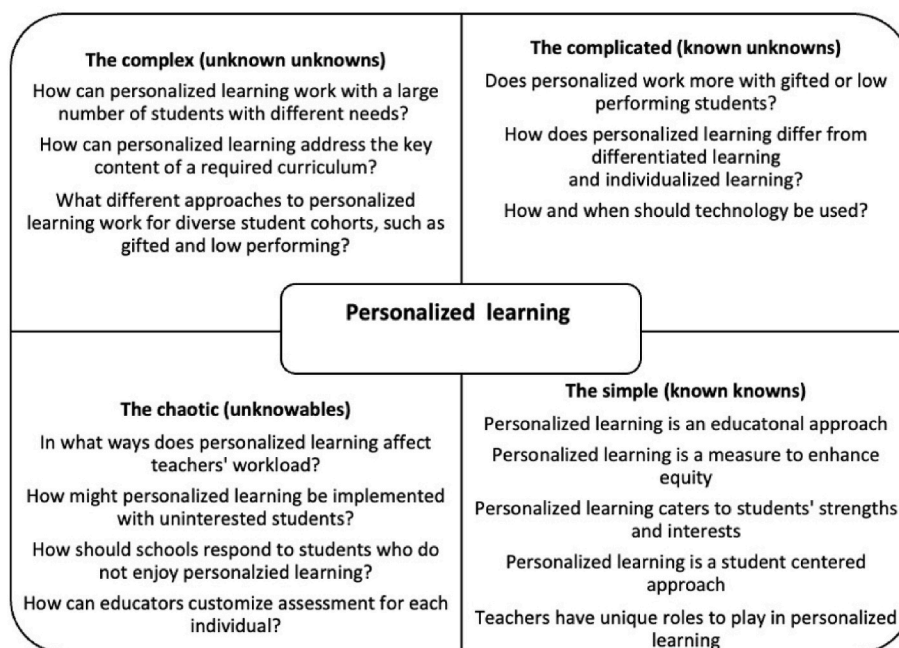


Fig. 1. Teachers' responses to personalized learning through the lens of the complexity theory.

their learning needs and literacy ability. So like, we still had to teach a certain amount of content about how to write stories and such. But it was pitched very differently for students of lower literacy than it was for a standard class of that year. So the skills were still the same, much the same, but, the expectation of work out of quality of work and the output of work was different".

Table 1 illustrates how the teachers in this study shared a basic understanding of what personalized learning entails. The teachers were able to define personalized learning and their definitions shared common attributes, suggesting a relatively clear theoretical basis and that, for this group of participants, understanding personalized learning in theory might fall under the Simple classification. Teachers' perceptions of personalized learning were largely based on student-centeredness, which is well summarised by Derrick's description of how to cater to individual needs not only by modifying activities but also by redesigning assessment tasks. In it, they emphasize the importance of modifying and redesigning assessments to meet the needs of students.

"Because you learn differently, you'll have a modified piece of assessment that will help you better prove your skill in, in the fields, we're assessing ... if you know that this student might not take to the same material as everybody else, modifying that material in the ways present to everyone else to accommodate that student is often easier than, um, making a separate piece just for that student".

Participants in the study viewed personalized learning as a student-centric approach to learning that can cater to a variety of student goals, strengths, needs, and desires. George reinforced this idea by emphasizing that students expect their teachers to know their interests: "Biggest thing they want to know is that you know their interests. And you can engage them through their interests." It became evident, when personalized learning was further discussed, that the teachers were on equal footing as far as its student-centered nature was concerned.

As suggested by Derrick, changes to teaching, learning, and assessment were to be facilitated with students' interests in mind, thereby also implying a student-centered approach:

"There are adaptations made in the work and sometimes even assessment pieces to accommodate them. I strive to try and normalize the work across the class where I can. So if I know

someone has those individual needs, rather than giving them different work, I might incorporate those needs into the way I'm designing material for a class. And, other than that, it's about spending more time, one on one with students who I know struggle with literacy or understanding and making sure they stay on task and comprehend the work".

Emphasizing the role of the teacher in personalized learning, George, as Design Technology teacher in the middle years, explained:

"My role is not teaching per se. It's facilitated. My role is to question them about what they're doing, you know, sometimes play students' advocate about why they are doing things this way. Not another way. And to cement with them. You know, what is the better way to, for them to go so yeah, so my role in personalized learning is. yeah. Is facilitating that journey. But also, you know, if they want to challenge themselves and go outside their box, to teach them the skills they need, like indirectly, so they can move forward and apply those skills for themselves".

In addition, teachers' opinions emphasized the idea that being fair and impartial for each and every individual was an essential component of learning, and that personalized learning could be used to enhance this kind of equity. Derrick explained this idea as "to sort of individualize the instruction based on the Australian curriculum standards for that year group. And then modify it for their learning needs and literacy ability". While personalized learning appeared straightforward in theory, it became considerably less so in practice.

### 3.2. The complicated

While participants held common perspectives on the definition and student-centric nature of personalized learning, their perceptions about the implementation of the practice revealed a greater diversity of opinion. Teachers found certain elements of personalized learning to be complicated. Complicated problems are ones in which cause, and effect cannot be seen immediately but which can be deduced through analysis (Snyder, 2013; Turner & Baker, 2019). For example, teachers wondered if personalized learning was more suitable for some groups of students than others. Based on the data gathered, some participants viewed personalized learning as an educational approach most appropriate for

gifted and talented students or low-performing students, suggesting that personalized learning should only be used among a small group of students. Lilly, who taught English Language and Literature, viewed personalized learning implementation as follows:

“Last year I had what they called a P class, which was students with identified learning difficulty ... it doesn't have to always be from perceiving it from a deficit perspective, necessarily. It could be for a very bright student who may need an extension. So by offering that extension, but in an area that may be of their personal interest, I do think it lends itself to, I think it lends itself to a smaller group of students who need it”.

Adding to this view, participants stated that personalized learning implementation would be more successful in primary schools than in secondary schools. Elena taught several subjects in years 7–10, and she described, “Okay so I think with my primary students, reading projects is probably really successful, and I'm trying to implement it with my high schools, but it's looking harder.”

Another source of confusion was the participants' perception of personalized learning as it was currently being implemented. Participants identified personal projects and research essays as the current modes of personalized learning implementation. “I mean, that's the personal project is ultimately in personalized learning” (Lilly). Another explained, “So my year nine, 10, uh, metalwork class, they do personalized projects” (Amanda).

“And in the DP programming, you've got the extended essay and I'm talking about my faculty. Uh, all of them are extended essays and in English, I'm familiar with that. And that is in personalized learning. You know, so there are lots of forms of personalized learning” (Hendry).

Teachers reported that the implementation of personalized learning led to unpredictability and created a dilemma regarding how it could be implemented on a practical level. While some participants viewed personalized learning as most suited for gifted students to extend their talents, other participants viewed personalized learning as most suitable for students who were typically less successful in class. Derrick explained it as follows:

“... specifically for ILP students, so they often require different materials because of, uh, mental conditions or uh, social conditions like dyslexia or trauma backgrounds. So there are adaptations made in the work and sometimes even assessment pieces to accommodate them”.

“I actually ran some specifically low literacy classes, which were very low student count classes, and a lot of the work was targeted for those sorts of kids and then we'd help them out individually, even further based on the work we gave out”.

In addition, some teachers reported that personalization also required increased technology use, which led to additional challenges. For example, Amanda, a Technologies teacher, emphasized that sometimes it was:

“easier just to ignore that student on his phone so he can continue the lesson. So it's constant monitoring. Are they on your work? Are they playing a game? Are they switching screens when you are not there? That's massive”.

This was Amanda's bittersweet experience, and it was unclear as to how to make the most of it. She lamented that “... we are so encouraged to use technology and I love technology, in all facets, but I do feel that this, we see it every year, more and more students being so addicted to the technology.”

Thus, data suggested that some concepts pertaining to implementation were complicated for teachers. Several questions persisted, including to whom the practice was most suitable, whether it could be

implemented to the whole class following an inclusive approach to personalized learning, and the nature of technology's role within it.

### 3.3. The complex

The complexity of personalized learning was evident in teachers' descriptions of its current implementation and how it might be implemented in the future. Complex problems are those that lead to continuous flux and unpredictability; there are no right answers, only emergent behaviors (Snyder, 2013). It is a realm where expertise is useful but insufficient for solving the problem. For example, despite their interest in employing personalized learning, participants wondered how it would work in a class of 28–30 students within a limited period of time. Elena questioned how a teacher could manage personalized learning in a secondary school setting with limited time with their students as per the current structure for schooling; They said:

“I only see my students for three hours a week. Yes. You know, like, so you, by the time you get to know them, and then you've got, you know, only five more weeks to get something done. So yeah, it's it, that makes it really difficult ...”.

Moreover, a set or prescribed curriculum made the matter complex for many participants. They could not understand how one could manage the curriculum within a structure that expected individual teachers to work alone in covering the areas in the curriculum. They noted the difficulty of implementing personalized learning in a classroom due to the confusion regarding the existing curriculum and its potential timetabling implications. Lilly mused:

“I suppose the biggest challenge would be, how would we implement the curriculum as in the timetable? How would we implement that in terms of, do you do it within the class and so how much support do you get in the class so that you can run both those programs at the same time?”.

Further complexity associated with personalized learning was present in participants' divided opinions as to the impact of implementing personalized learning at different levels of schooling. They agreed that a personalized system could work better in primary school as one teacher plans the work. There was some agreement among participants that implementing personalized learning for secondary school students would be more difficult due to curriculum obligations, the number of subjects, and the number of students in a class.

### 3.4. The chaotic

In many ways, teachers found the application of personalized learning strategies to be rather messy or chaotic, and more easily said than done. For example, some major issues included managing student behaviours, helping students identify their interests, customizing assessments for each individual etc. The chaotic realm is an area of tremendous turbulence with a lack of clear cause-and-effect relationships that make attempts to identify them futile (Snyder, 2013). Amanda explained that she was exhausted by a particular student and lacked strategies to get him interested in learning. She offered:

“I have tried everything ... So, I sat and chatted with him the other day and he comes out. He and his friends hack games. So how I understand is they take a game, and they create new characters for it and stuff like that. Should I help him to hack games?”

Teachers also thought that it was hard to identify students' interests. Amanda explained, “I have a dual technology class at the moment that they're fabulous kids, but they're not kids that's obsessed with their phones in that way. So, they're not, they're not really technology kids”.

Derrick noted that getting students interested in doing things they like was also harder because, “Just even get them interested in their

own problems, sometimes their own (personal) problems are so much bigger than anything”.

Some participants also felt that some students abused the flexibility they were given, for example, teenagers playing games with technology when they were not supervised. Amanda noted, “It is like constant monitoring. Are they on your work? Are they playing a game? Are they switching screens when you’re not there?”. Personalized learning was implemented in various ways, and issues of student engagement proved challenging.

The participants found the assessment of student’s strengths also to be challenging. For instance, they wondered if tests should be used with students in personalized learning. “... because you learn differently, you’ll have a modified piece of assessment that will help you better prove your skill in, in the fields, we’re assessing” (Derrick). Further Derrick explained, “more time is, is an accommodation. So, lower assessment, and deadline pressures, usually help with that”.

“So you’d probably all start them with a pre-assignment, something that is the same throughout. So to get a baseline .... Get the baseline and then evaluate their abilities from that. Look at their path testing, schools, and stuff like that. And then modify the various assessments. So for the ones that did really well look at how to challenge them. Yeah. And then the ones that really struggle, see how we can support them to bring them to make them” (Amanda).

Messiness was also evident in the realm of behavior management. Amanda noted that she had to deal with issues with deviant groups of students in the school with ‘ring leaders’ that distract other students creating a unique culture in the school. She described, “they just are not interested in work at all, renowned for truanting ... wanting to constantly sit on their phones, very deviant ... I try to do different things to get them interested but not always successful”. A few other teachers also expressed concerns about students’ behavior issues that are beyond their control.

### 3.5. Summary of findings

When summarizing teachers’ conceptualizations of personalized learning (Research Question 1) they found personalized learning to be a clear and well-defined concept, suggesting that it has a significant theoretical foundation. Teachers shared the view that personalized learning was a means of customizing learning opportunities to individual student needs, strengths, passions, and interests. However, stark differences of opinion among teachers emerged when delving into the practical aspects of its implementation. This revelation highlights the complexity of personalized learning, a concept that appears straightforward in theory, but becomes considerably more complex when embodied in practice. This juxtaposition of theoretical clarity and practical complexity underscores the challenges inherent in translating the concept into effective classroom practices.

Table 2 depicts these teachers’ instructional approaches (Research Question 2), conveying that they used a variety of approaches to personalize learning. Analysis of the data showed that the same levels of complexity existed with the strategies and their applications with all students in their classes. Some strategies were simple, but complications and complexities arose particularly when teachers attempted to address individual needs and the demands of the curriculum (see Table 3). Keeping the learners engaged and sustaining learner motivation were key chaotic factors in the application of the strategies. The sanctioned curriculum posed challenges for teachers as they attempted to address students’ needs and interests.

The teachers’ concerns over implementing personalized learning within the secondary school context added another layer of complexity (see Table 3). Teachers highlighted challenges that included limited time available for individual student attention, existing curriculum constraints, many students in each class, and the burden of handling

**Table 2**  
Participant demographics.

Name	Gender	Subject	Year Level	Teaching Experience
Amanda	Female	Textile Technology Food Technology Digital Technology	Year 07–10	11 years
Derrick	Male	Humanities and Social Sciences Studies of Society and Environment English	Year 10	Over 05 years
Elena	Female	Language Literature English Drama	Year 07–10	10 years
George	Male	Food Technology Design Technology in Woodwork, Metalwork, and Product Design	Year 07–10	13 years
Hendry	Male	Primary Years Program Coordinator	Year 07–10	20 years
Lilly	Female	English Language and Literature	Year 07–10	20 years
Patricia	Female	Mathematics	Year 07–10	15–20 years

multiple subjects. Further, even though the consensus leaned towards personalized learning being more suitable for primary students, the teachers remained unsure about the practicalities of its implementation at that level as well.

The real-world educational landscape presents several barriers to personalized learning, which require thoughtful and tailored approaches in order to overcome them. Realizing the full potential of personalized learning and its positive impact on student outcomes requires finding innovative solutions to address the specific challenges identified by teachers. Therefore, further research and collaboration among educators, administrators, and policymakers is essential to navigating the complexities of personalized learning and to maximizing its benefits.

## 4. Discussion

Overall, the lens of complexity theory provided useful insights into teachers’ perceptions of personalized learning. This study’s findings shed light on personalized learning implementation by crystalizing and delimiting several issues surrounding this approach.

First, there appeared a paradox between teachers’ enthusiasm and their wariness. Students’ disengagement is one of the key issues that educators regularly confront in Australian schools (Goss, Sonnemann, & Griffiths, 2017). Indeed, in their interviews, participants described their lived experience teaching diverse groups of students: the motivated and unmotivated, the engaged and disengaged. These teachers had seen the demarcations of the current system of education. Yet they were enthusiastic about personalized learning as a construct that recognized all students’ learning as important and worried that personalized learning would disappear from the discourse of the Directorate of Education, as has been noted in other contexts (Stockill, 2011). They expressed empathy for students, particularly those who did not enjoy traditional learning approaches. These teachers wanted to bring about change in their classrooms. They vehemently felt that students would be more engaged if their learning opportunities were better aligned with their interests and provided them with greater agency. None denied personalized learning’s potential, and in fact, all participants agreed that it was attractive in theory.

At the same time, however, the teachers’ confusion and wariness of personalized learning crept in when they described its implementation. They agreed that pragmatic instructional strategies were necessary. Prain et al. (2013) asserted that “learning depends on the expertise of teachers to support students” (p. 672) and indeed these participants

**Table 3**  
Teachers' current instructional approaches to personalize instruction.

Teacher* Pseudonyms	Instructional Strategies	Complexity Theory Analysis			
		The simple (Known knowns)	The complicated (Known unknowns)	The complex (Unknown and unknowns)	The chaotic (Unknownables)
Amanda	Design thinking Engineering discussions Using a cycle for individual assessments	How to write a procedure Scaffolding writing Provide examples of prototypes & evaluations	How to help everyone to research appropriately, how to analyze, and evaluate data (the process)	Cater to students with specific needs such as dyslexic students	How to cater to diverse individual students' needs in a big class
Derrick	Story projects Modifying assessments for students who have individual learning plans	Teach content explicitly (such as stories)	Support students of lower literacy needs in a standard class	Individualize instruction based on the, the Australian curriculum standards for the year group and then modify it for their learning needs and literacy standards	Meet the expected curriculum standard for all students
Elena	Projects based learning rather than just writing an essay and handing it in	Getting them to pick the topic that they want to research Scaffold students with the process of research	Some approaches work well with some students but do not work with some others Manage students with diverse interests	Link the curriculum content to a project that they design themselves	A lack of student motivation and engagement for learning anything at all Personalize projects for students with deviant behavior
George	Personalized Projects	Students select their topics. Facilitate discussions	To challenge themselves and go outside their box	To explicitly teach them the skills they need so they can move forward and apply the skills	Address subject specific content catering to individual student needs
Hendry	Inquiry-based learning	Help structure inquiry questions Provoke the kids thinking in those areas	To find out what the kids know about it, and to find out what interests them to drive learning	Help students with poor literacy skills	Negotiate the Australian Curriculum with their needs
Lilly	Under IB curriculum – the personal project Extended essays	Provides students with their choice.	Relate to students' identities in a big class	Assess them completely differently. Or Assess them on different outcomes	Modifying the curriculum beyond conceptual understanding for deep learning
Patricia	Game-based learning	Talk around the interest in games	Provide examples (my own examples)	Integrate skills into game-based learning	Assessment of skills in relation to the curriculum

were eager for new strategies that 'made sense' to them. They reported confusion about how, when, and where personalized learning should be used, and wondered if the practice was best suited for certain populations of students. Amanda's earlier observation that some students are "just are not interested in work at all, renowned for truanting ... very deviant" illustrated how some teachers perceive a subculture of antagonism toward the school system, thus underscoring the importance of engaging students and adopting more person-centered education.

The co-existence of teachers' enthusiasm and wariness is understandable in a context in which they comprehend the purpose of a practice but lack the discrete strategies to implement it. With student engagement as a core objective, personalized learning might best be constructed in partnership with learners. Just as Fielding (2006) argued that by working together with children as "co-enquirers and co-contributors" (p. 365), teachers can create a person-centered learning community that may resolve the issues with student engagement.

## 5. Implications

This study suggests that the implementation of complex educational approaches such as learning might be advanced through the application of complexity theory. Examining participants' perceptions of a practice through this lens may enable the identification of possible paths forward. For instance, issues classified as *simple*, such as a shared definition of learning, could become a helpful foundation upon which school leaders could build future action. *Complicated* issues, such as the question of how personalized learning differs from differentiation, could be identified by a school's leadership team for immediate resolution through reading and/or professional development. To address the *complex* issues, such as how personalized learning might work in the context of a required curriculum with multiple objectives, school stakeholders could "create safe spaces for patterns to emerge" (Snyder, 2013, p. 8) and set the stage for action research, wherein educators

collect data to answer the unresolved question(s). As Snyder noted, "expertise is useful but not sufficient to solve complex problems – great patience and a sharp eye for new behavioral patterns are the only way forward" (Snyder, 2013, p. 8). Finally, Snowden and Boone (2007) recommended treating *chaotic* issues, such as how an educator should respond to students who are disengaged from learning, as complex and developing a mechanism to deal with complexity.

Participants of this study adopted strategies such as project-based learning, inquiry-based learning, game-based learning, and individual projects (see Table 2). They unanimously advocated the strengths of such pedagogical approaches. While research highlights the strengths of such practices (Stewart, 2017) their implementation with all learners proved problematic, as not all learners engaged as expected. Teachers in the present study selected these strategies predominantly of their popularity, as opposed to choosing those which matched their learner profiles, suggesting a need for teachers to learn more about learner identities. There are possible issues inherent in adopting such techniques in the name of personalized instruction, irrespective of their strengths or popularity.

The potential of learning lies in teachers allowing their students to have a voice in choosing how to learn and flexibility not only in choosing the topics but also in co-design of learning (Bishop et al., 2019). Teachers might also benefit from considering structures such as Taylor and Hunt's (2021) model that provided a structure to project-based learning: Educate, Act, Connect, and Communicate. Such a structure enables teachers to spend time with individual students focusing on their learning at different stages of the project. In this sense, it is not the pedagogy that matters most in personalized learning, rather it is the students' voice, choice and flexibility. As seen in this study as well as in other studies such as Fake and Dabbagh (2020), set assessment is an obstacle for implementing personalizing learning. Revisiting our assessment practices is a need in this century to help students learn and to consider assessment as part of learning.



As argued by Bishop et al. (2019), schools need to ensure that all three pillars are strong in the application of personalized learning: personalized learning plans to explore learner identities, flexible pathways to allow students flexibility, and proficiency-based assessment to track students' learning. The absence of any one pillar makes the learning situations chaotic for teachers, as was evident in our data. Previous studies have explored some practical ways to enact personalized learning. The below section provides some suggestions for practitioners to explore this space.

## 6. Some implications to enact learning

As asserted in the literature review section of this paper, there is no one best way to implement learning (Zhang, Basham, & Yang, 2020a; 2020b). However, research provides some useful insights for teachers to consider when attempting to enact personalized learning (Bishop et al., 2019; Stewart, 2017) some of which are supported by the participants of this study.

1. Explore learner identities. Teachers need to know their students well enough to implement personalized learning (Rubin & Sanford, 2021). Teachers also need to know themselves well, to develop a positive relationship with their students. Identity is an important concept that is worth exploring. Learner identity is not static - identity is a concept that was developed with the assumption that all people can develop, learn and change (Kolb & Kolb, 2009). It is the foundation of social constructivist learning.
2. Provide flexibility in how students learn (Bishop et al., 2019; Stewart, 2017). Flexible pathways help engage all learners in the learning process. This will enable students to take control of their learning and develop their agency.
3. Adopt assessment that is authentic (Stewart, 2017) and proficiency based. One purpose of the assessment is to make sure that students are meeting the desired outcomes of learning. Assessment ensures that students are making progress by applying the skills and knowledge they acquire in the formal education system. The standards tests or national assessments often do not provide a learner with indicators or success criteria for their learning. Grading or grades can be arbitrary and discouraging for students. Competency-based Assessment (CBA) or proficiency-based assessment allows students to see the continuum of their learning, and the areas that they need to develop and provides an indication of measures to develop them. Research such as Stewart (2017) also shows that "providing authentic assessment for learning is at the core of learning" (p.3). CBA sets the bar high for each individual student.

Research also shows that the absence of one of the three pillars above can dismantle the process, hence, teachers need to ensure they understand the logic behind the application of the above principles to promote (Bishop et al., 2019; Fake & Dabbagh, 2020). As argued by complexity theorists, it is important for teachers to envisage the complexity within it to be innovative and creative. Further research gathering student data will support drawing further insights into practicalities and possibilities to ensure personalized learning increases student engagement and fosters student agency.

## 7. Conclusion

The teachers in this study strongly and unanimously believed in the principles of personalized learning, yet they struggled with how to implement them within the current structure of schooling. The application of complexity theory allowed us in this study to understand how teachers navigate personalized learning by working on the simple (known knowns), dealing with the complicated (known unknowns), coping with the complex (unknown unknowns), and managing the chaotic (unknowable). This model has provided a tool for envisioning

the issues confronted with teacher professional development of personalized learning to develop a 'sweet spot' strategy to invigorate teachers or assist them to pave the way as they evolve and sustain in managing this complexity. The school has a five-year plan for teachers to innovate in their own way. The work is ongoing in this research context and more teachers have volunteered to explore how personalized learning can be implemented.

The use of complexity theory as a conceptual and analytical framework helped to classify the challenges and make sense of teachers' concerns, which fell most commonly in the following areas:

- Negotiating the expected curriculum when teaching to students' strengths and interests
- Managing a timetable restricting teachers to a few hours each week with each class
- Personalizing learning opportunities for large numbers of students in the classroom
- Customizing assessments to suit each student

It is often a challenge for teachers to navigate through an imposed curriculum, but the curriculum should not be a barrier to students' growth, developing a love of learning by connecting with communities and beyond. It is unlikely that addressing personalized learning issues in isolation and seeking reductionist approaches will result in a holistic, lasting change. To perform effectively in a complex realm requires an in-depth understanding of complexity itself, not only on the part of teachers but also of students and other stakeholders. Embracing the complexity and understanding the paradox need not be viewed as rejection or risk aversion; rather it is a starting point to exploring new approaches, which can be chaotic, yet can also propel innovation and creativity.

Student learning is not solely determined by their personal characteristics or abilities, but also by their interactions with the curriculum, teachers, and peers within the learning environment. Complex realms such as education are rarely improved through generic or superficial solutions. In fact, education is commonly viewed as a complex process that requires complex responses (Atkin, 1996). As such, expecting a simple black-or-white solution to such challenges is an exercise in futility (Atkin, 1996), resulting in a great deal of uncertainty for all concerned. With this challenge as a guide, a pathway is opened to explore innovative measures that will enable us to convert the notions of impossibility and/or uncertainty into possibility and/or certainty. Complexity theory can help us better understand educational issues inherent in different learning environments to design better solutions. By applying complexity theory in educational settings, it is possible to better understand how complexities surrounding the physical environment, student-teacher relationships, and learning material interact to create an effective learning environment.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

## Acknowledgment

Authors would like to thank the funder, ACT Directorate of Education, for their support by providing funds for this study.

## References

- ACT Government. (2018). *The future of education: An ACT education strategy for the next ten years* [PDF document] <https://www.education.act.gov.au/our-priorities/future-of-education/resources/The-Future-of-Education-An-ACT-Education-Strategy-for-the-Next-Ten-Years>.
- Alamri, H., Lowell, V., Watson, W., & Watson, S. L. (2020). Using learning as an instructional approach to motivate learners in online higher education: Learner self-determination and intrinsic motivation. *Journal of Research on Technology in Education*, 52(3), 322–352. <https://doi.org/10.1080/15391523.2020.1728449>
- Allen, J., Rowan, L., & Singh, P. (2018). Through growth to achievement: The potential impact on teacher education of the 2018 Gonski Review. *Asia-Pacific Journal of Teacher Education*, 46(4), 317–320. <https://doi.org/10.1080/1359866X.2018.1507067>
- AndhariniDwi, C., & Basuki, A. (2012). Learning path of a web-based learning system. *International Journal of Computer Applications*, 53, 17–22. <https://doi.org/10.5120/8434-2206>
- Atkin, J. (1996). *From values and beliefs about learning to principles and practice*. IARTV. [https://www.taumata.school.nz/school/content/From-Values-&Beliefs-to-Prin-&Prac\\_\(3\).pdf](https://www.taumata.school.nz/school/content/From-Values-&Beliefs-to-Prin-&Prac_(3).pdf).
- Basham, J. D., Hall, T. E., Carter, R. A., Jr., & Stahl, W. M. (2016). An operationalized understanding of learning. *Journal of Special Education Technology*, 31(3), 126–136. <https://doi.org/10.1177/0162643416660835>
- Bernacki, M. L., Greene, M. J., & Lobczowski, N. G. (2021). A systematic review of research on learning: By whom, to what, how, and for what purpose(s)? *Educational Psychology Review*, 33(4), 1675–1715. <https://doi.org/10.1007/s10648-021-09615-8> [Review].
- Bishop, P. A., Downes, J. M., & Farber, K. (2019). *Learning in the middle grades: A guide for classroom teachers and school leaders*. Harvard Education Press.
- Bloom, B. S. (1973). Recent developments in mastery learning. *Educational Psychologist*, 10(2), 53–57. <https://doi.org/10.1080/00461527309529091>
- Bloom, B. S. (1984). The 2 Sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. *Educational Researcher*, 13(6), 4–16. <https://doi.org/10.3102/0013189x013006004>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Campbell, R., Robinson, W., Neelands, J., Hewston, R., & Mazzoli, L. (2007). Personalized learning: Ambiguities in theory and practice. *British Journal of Educational Studies*, 55(2), 135–154. <https://doi.org/10.1111/j.1467-8527.2007.00370.x>
- Chen, S. Y., Huang, P.-R., Shih, Y.-C., & Chang, L.-P. (2016). Investigation of multiple human factors in learning. *Interactive Learning Environments*, 24(1), 119–141. <https://doi.org/10.1080/10494820.2013.825809>
- Davis, A. P., Dent, E. B., & Wharff, D. M. (2015). A conceptual model of systems thinking leadership in community colleges. *Systemic Practice and Action Research*, 28(4), 333–353. <https://doi.org/10.1007/s11213-015-9340-9>
- Dewey, J. (1902). *The child and the curriculum*. University of Chicago Press.
- Dewey, J. (1903). Democracy in education. *The Elementary School Teacher*, 4(4), 193–204. <https://www.jstor.org/stable/992653>.
- Dockterman, D. (2018). Insights from 200+ years of learning. *Npj Science of Learning*, 3(1), 15. <https://doi.org/10.1038/s41539-018-0033-x>
- Duit, A., Galaz, V., Eckerberg, K., & Ebbesson, J. (2010). Governance, complexity, and resilience. *Global Environmental Change*, 20(3), 363–368. <https://doi.org/10.1016/j.gloenvcha.2010.04.006>
- Duncan, A. (2013). How technology will revolutionize testing and learning: Greater broadband access will bring the latest digital tools to more teachers and students. *Scientific American*, 309, 69–71. <https://www.scientificamerican.com/article/arneduncan-howtechnology-will-revolutionize-testing-learning>.
- Fake, H., & Dabbagh, N. (2020). *Learning within online workforce learning environments: Exploring implementations, obstacles, opportunities, and perspectives of workforce leaders*. *Technology* (Vol. 25). Knowledge and Learning. <https://doi.org/10.1007/s10758-020-09441-x>
- Fielding, M. (2006). Leadership, personalization and high-performance schooling: Naming the new totalitarianism. *School Leadership & Management*, 26(4), 347–369. <https://doi.org/10.1080/13632430600886889>
- Gonski, D., Arcus, T., Boston, K., Gould, V., Johnson, W., O'Brien, L., et al. (2018). Through growth to achievement: The report of the review to achieve educational excellence in Australian schools (1760514217). <https://files.eric.ed.gov/fulltext/ED586130.pdf>.
- Goss, P., Sonnemann, J., & Griffiths, K. (2017). *Engaging students: Creating classrooms that improve learning*. Grattan Institute. <https://grattan.edu.au/wp-content/uploads/2017/02/Engaging-students-creating-classrooms-that-improve-learning.pdf>.
- Groff, J. S. (2017). *learning: The state of the field & future directions*. Center for Curriculum Redesign. <https://www.media.mit.edu/publications/personalized-learning/>.
- Herold, B. (2017). learning: Modest gains, big challenges, RAND study finds. *Education Week*. [https://blogs.edweek.org/edweek/DigitalEducation/2017/07/\\_learning\\_research\\_implementation\\_RAND.html](https://blogs.edweek.org/edweek/DigitalEducation/2017/07/_learning_research_implementation_RAND.html).
- Jenkins, J. M., & Keefe, J. W. (2002). A special section on instruction in two schools: Two approaches to learning. *Phi Delta Kappan*, 83(6), 449–456. <https://doi.org/10.1177/003172170208300610>
- Kvale, S. (1994). *Interviews: An introduction to qualitative research interviewing*. Sage Publications, Inc. <https://doi.org/10.1080/00405849509543675>
- Li, K. C., & Wong, B. T.-M. (2021). Features and trends of personalized learning: A review of journal publications from 2001 to 2018. *Interactive Learning Environments*, 29(2), 182–195. <https://doi.org/10.1080/10494820.2020.1811735>
- Mason, M. (2008). Complexity theory and the philosophy of education. *Educational Philosophy and Theory*, 40(1), 4–18. <https://doi.org/10.1111/j.1469-5812.2007.00412.x>
- Montessori, M. (1912). *The Montessori Method: Scientific pedagogy as applied to child education in the children's houses*. Frederick A. Stokes Company. <https://archive.org/details/montessorimethod00montouft/page/n7/mode/2up>.
- Morrison, K. (2002). *School leadership and complexity theory*. Routledge.
- Morrison, K. (2010). Complexity theory, school leadership and management: Questions for theory and practice. *Educational Management Administration & Leadership*, 38(3), 374–393. <https://doi.org/10.1177/1741143209359711>
- Nagle, J. F., & Bishop, P. (2021). Learning for social justice: From theory to practice. *Middle Grades Review*, 7(2), 1. <https://scholarworks.uvm.edu/mgreview/vol7/iss2/1>.
- Needham, C. (2011). Personalization: From storyline to practice. *Social Policy and Administration*, 45(1), 54–68. <https://doi.org/10.1111/j.1467-9515.2010.00753.x>
- O'Donnell, M. (2021). Student agency through negotiated practice. *Middle Grades Review*, 7(2), 9. <https://scholarworks.uvm.edu/mgreview/vol7/iss2/4>.
- OECD. (2006). *Schooling for tomorrow: Personalizing education*. Center for Educational Innovation.
- Patrick, S., Worthen, M., Frost, D., & Gentz, S. (2016). Promising state policies for learning. <https://files.eric.ed.gov/fulltext/ED567893.pdf>.
- Prain, V., Cox, P., Deed, C., Dorman, J., Edwards, D., Farrelly, C., et al. (2013). Personalized learning: Lessons to be learnt. *British Educational Research Journal*, 39(4), 654–676. <https://doi.org/10.1080/01411926.2012.669747>
- Pykett, J. (2009). Personalization and de-schooling: Uncommon trajectories in contemporary education policy. *Critical Social Policy*, 29(3), 374–397. <https://doi.org/10.1177/0261018309105176>
- Rubin, S. C., & Sanford, C. (2021). *Pathways to personalization: A framework for school change*. Harvard Education Press. October 23, 2018.
- Shemshack, A., Kinsluk, & Spector, J. M. (2021). A comprehensive analysis of learning components [Article]. *Journal of Computers in Education*, 8(4), 485–503. <https://doi.org/10.1007/s40692-021-00188-7>
- Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review*, 85(11), 68. <https://hbr.org/2007/11/a-leaders-framework-for-decision-making/>.
- Snyder, S. (2013). "The simple, the complicated, and the complex: Educational reform through the lens of complexity theory". In *OECD education working papers* (Vol. 96) Paris: OECD Publishing. <https://doi.org/10.1787/5k3txmpt1lnr-en>.
- Stewart, D. (2017). Personalized learning pedagogies within contemporary schools. *Journal of Initial Teacher Inquiry*, 3, 7–11. <http://hdl.handle.net/10092/14630>.
- Stockill, J. (2011). *Student-focused strategies: Supporting achievement*. National College for School Leadership. [www.nationalcollege.org.uk/researchassociates](http://www.nationalcollege.org.uk/researchassociates).
- Taylor, D., & Hunt, K. (2021). Principles of pathways for sustainability education: Educate, act, connect, and communicate. *Middle Grades Review*, 7(2), 5. <https://scholarworks.uvm.edu/mgreview/vol7/iss2/5>.
- Tolmie, E. (2016). *Implementing personalized learning in New Zealand primary schools innovative learning environments. (An unpublished thesis submitted in partial fulfilment of the requirements for the degree of Master of Educational Management and Leadership)*. New Zealand: Unitec Institute of Technology.
- Turner, J. R., & Baker, R. M. (2019). Complexity theory: An overview with potential applications for the social sciences. *Systems*, 7(1), 4. <https://doi.org/10.3390/systems7010004>
- United Nations Educational. (2017). *Training tools for curriculum development: Learning, International bureau of education*. Scientific and Cultural Organization. <https://unesdoc.unesco.org/ark:/48223/pf0000250057>.
- Waldrup, B., Yu, J. J., & Prain, V. (2016). Validation of a model of personalized learning. *Learning Environments Research*, 19, 169–180. <https://doi.org/10.1007/s10984-016-9204-y>
- Yin, R. K., & Davis, D. (2007). Adding new dimensions to case study evaluations: The case of evaluating comprehensive reforms. *New Directions for Evaluation*, 2007(113), 75–93. <https://doi.org/10.1002/ev.216>
- Zhang, L., Basham, J. D., & Yang, S. (2020a). Understanding the implementation of learning: A research synthesis [Review]. *Educational Research Review*, 31, 1–15. <https://doi.org/10.1016/j.edurev.2020.100339>. Article 100339.
- Zhang, L., Yang, S., & Carter, R. A. (2020b). Learning and ESSA: What we know and where we go. *Journal of Research on Technology in Education*, 52(3), 253–274. <https://doi.org/10.1080/15391523.2020.1728448>
- Zheng, H. (2013). Teachers' beliefs and practices: A dynamic and complex relationship. *Asia-Pacific Journal of Teacher Education*, 41(3), 331–343. <https://doi.org/10.1080/1359866X.2013.809051>

to ensure that all students have the opportunity to achieve their full potential. Through her research, she intends to find measures to close the opportunity gap between the privileged

and the underprivileged students, and ensure that all students are given the chance to succeed.