Contemporary Educational Technology, 2022, **14**(4), ep385
ISSN: 1309-517X (Online)

OPEN ACCESS

Research Article

Personalized Learning Practice in U.S. Learner-Centered Schools

Dabae Lee [1]
0000-0001-9641-2015

Yeol Huh [1*]
0000-0002-3313-4262

Chun-Yi Lin [2]
0000-0001-5513-2391

Charles Morgan Reigeluth [3]
0000-0001-6075-5155

[1] Department of Instructional Technology, Kennesaw State University, Kennesaw, GA, USA
[2] Department of Education & Graduate Institute of Curriculum and Instruction, National Taiwan Normal University, Taipei, TAIWAN
[3] Department of Instructional Systems Technology, Indiana University, Bloomington, IN, USA
[*] Corresponding author: yeolhuh@gmail.com

Citation: Lee, D., Huh, Y., Lin, C.-Y., & Reigeluth, C. M. (2022). Personalized learning practice in U.S. learner-centered schools. *Contemporary Educational Technology, 14*(4), ep385. https://doi.org/10.30935/cedtech/12330

ARTICLE INFO

Received: 23 Jun 2022
Accepted: 25 Jul 2022

ABSTRACT

Personalized learning (PL) has been internationally promoted as a future direction of educational reform efforts. While there is growing evidence of PL enhancing learning outcomes, teachers reported having difficulty envisioning PL in practice. This national survey study investigated how PL is practiced in K-12 learner-centered schools in the U.S. to inform educators of learner-centered teachers' PL practice and identify gaps between their practice and research. Five essential components were identified: PL plans, competency-based student progress, criterion-referenced assessment, project- or problem-based learning, and multi-year mentoring. Based on the five components, we identified 308 learner-centered schools and received 272 teacher responses from 41 schools. The five components were implemented with different levels of implementation fidelity. We uncovered several areas in need of improvement. Career goals were not often considered when creating PL plans. A misalignment between student progress and assessment practice was found. There was a lack of community involvement during the PBL process. Teachers were not able to build a close relationship with all students. These findings from learner-centered schools revealed that paradigm change demands continuous effort to transform all aspects of the educational system. Suggestions are made for practice and future research.

Keywords: personalized learning, competency-based student progress, project-based learning, problem-based learning, multi-year mentoring

INTRODUCTION

Personalized learning (PL) is part of the learner-centered paradigm of education (American Psychological Association Presidential Task Force on Psychology in Education, 1993; Lambert & McCombs, 1998; McCombs, 2008; McCombs & Whisler, 1997) that is theoretically based on constructivism (Henson, 2003; Perkins, 1991). Constructivists, including Lev Vygotsky, Jean Piaget, and John Dewey, argued that knowledge is individually and socially constructed rather than transmitted between teachers and learners (Driscoll, 2005). Given its theoretical foundation, McCombs and Whisler (1997) defined learner centered as the dual focuses on

individual learners' characteristics and on the knowledge about how learning best occurs to drive instructional decision making.

The learner-centered paradigm is fundamentally different from the teacher-centered paradigm (American Psychological Association Presidential Task Force on Psychology in Education, 1993; Lambert & McCombs, 1998; McCombs, 2013). In the learner-centered paradigm, each student is considered as an active and unique contributor to their learning, whereas in the teacher-centered paradigm, students are considered passive receivers of standardized content that a teacher delivers to them (McCombs, 2008; Reigeluth & Karnopp, 2013).

The traditional teacher-centered educational system was designed to meet the needs of the industrial age, where a majority of the workforce performed repetitive tasks (Reigeluth, 2009). In this standardized system, students were challenged to learn the same material within a certain amount of time, to the detriment of slower learners. The system has long been observed as designed to fail those who did not make the cut (Bloom, 1968; Carroll, 1963) and thus sort factory workers from office workers (Reigeluth, 1987; Watson & Reigeluth, 2008).

In the current society, those factories and even some office workers who perform repetitive or routine tasks have largely been replaced by technology such as robots and artificial intelligence (World Economic Forum, 2020). International organizations emphasize that educational systems should be transformed to prepare a diverse workforce that can solve complex problems, work independently and collaboratively, and think strategically, critically, and creatively (OECD, 2018; World Bank, 2019; World Economic Forum, 2020).

Although the notion of PL has long been advocated (Bloom, 1968; Carroll, 1963; Dewey, 1938), it has been recently spotlighted as a learner-centered approach that may replace the standardized teacher-centered educational practice to meet the pressing societal needs for such a diverse and cognitively skilled workforce (Watson & Watson, 2016). The Organization for Economic Cooperation and Development's (OECD) Future of Education and Skills 2030 project gathered abundant resources and evidence to help countries pave their way to transform their educational systems to PL (OECD, 2018). The recent report by the International Association for K-12 Online Learning (iNACOL–now called the Aurora Institute) stated that

> "K-12 education is at the beginning of what many hope will be a systemic transformation toward PL" (p. 1).

Some national educational authorities have promoted PL. The U.K. Department of Education and Skills has adopted PL as a goal for educational reform in the U.K. In its five-year strategy, plans for enacting related policies and goals for educational systems, instructional practice, and learners at different levels were documented (Department for Education and Skills, 2004). In the U.S., the Every Student Succeeds Act (ESSA) of 2015 encourages PL and extensive use of data by promoting states to advance related policies and providing funding to states and school districts that have various needs for technology and professional development to adopt PL (Patrick et al., 2016a; Zhang et al., 2020).

PL is defined as customizing learning goals, content, methods, and pace to individual learners' unique characteristics and needs (U.S. Department of Education, 2010). As ideal as PL sounds, the actual implementation of PL in a school system may be a daunting task that requires a significant paradigm change in the school (Gross et al., 2018; Reigeluth & Karnopp, 2013). Because the learner-centered paradigm requires changes in so many interdependent parts of an educational system, transformation from the teacher-centered paradigm is far more difficult than piecemeal reforms within the teacher-centered paradigm (Reigeluth & Karnopp, 2020). The roles and mindsets of all stakeholders, including administrators, teachers, students, parents, and community members, should shift from teacher-centered to learner-centered (Gross et al., 2018; Reigeluth & Karnopp, 2020). Major changes should be made to the curriculum, instructional methods, school systems, and policies; and substantial investment should be made in renovating classrooms, providing professional development, and equipping proper technology (LEAP Innovations, 2020; Reigeluth & Karnopp, 2013; Watson & Reigeluth, 2008).

Unfortunately, PL seems abstract rather than concrete to many educators, so it is hard for many to envision what PL should look like in classrooms. In a multiple case study of the first four school district grantees of the U.S. federal Race to the Top program, all four grantees noted teachers' difficulties envisioning

what PL should look like (District Reform Support Network, 2016). These were the school districts that were selected as most ready for implementing PL and presented the most specific plans to transform. It can be even more challenging for other educators. The national survey conducted by iNACOL and other institutions revealed that K-12 teachers in regular schools struggled to envision PL in their day-to-day practice (Gross et al., 2018). A recent literature review on PL revealed that the changing role of teachers in PL should be further investigated despite the increased research on PL (Li & Wong, 2019). Due to the difficulty of paradigm change in an entire educational system, teachers often used PL as a supplemental or reactive instructional method rather than as the primary method (Bernacki et al., 2021). This piecemeal approach can be problematic because the effectiveness of PL depends on its implementation fidelity (Lee et al., 2021).

A few studies have been conducted on how PL has been practiced nationwide: two studies in the U.K (Sebba & Britain, 2007; Underwood et al., 2007) and one survey study conducted by iNACOL with teachers in regular schools in the U.S. (Gross et al., 2018). These studies provide valuable insights into the various ways that PL has been practiced in regular classrooms. However, current literature focuses on describing individual cases of those schools or examining a particular PL approach (Gross et al., 2018). There is a paucity of research that contributes to a broad understanding of how those learner-centered schools in the U.S. have implemented PL.

The purpose of this national survey is to systematically investigate PL practices in U.S. learner-centered schools that have adopted PL as the primary mode of instruction, thereby informing K-12 educators, researchers, and policymakers of how teachers in these schools have translated PL into their classrooms and what gaps still exist between research and practice in the learner-centered schools after years of practice of PL. The findings of this study shed light on potential challenges and solutions that may be useful to regular schools transitioning to PL in the years ahead.

CONCEPTUAL FRAMEWORK

PL encompasses individualization, differentiation, and personalization (U.S. Department of Education, 2010). Individualization refers to adjusting the pace to individual learners so that everyone can reach mastery. Differentiation refers to adjusting instructional methods to individual characteristics, but with the same learning objectives for all. Personalization includes individualization, differentiation, and tailoring learning goals and content to individual needs and interests.

Based on the definition of PL, Lee (2014) identified five components of PL, as follows:

1. a personalized learning plan (PLP), a learning plan for individual learners based on individual needs and characteristics that state learning goals, activities, and others,
2. competency-based student progress (CBSP) where students move on to the next topic after reaching mastery individually or by small groups rather than students advancing based on time,
3. criterion-referenced assessment (CRA) for ongoing formative assessment that checks students' understanding extensively and intensively and identifies learning deficiencies on the target content rather than norm-referenced assessment (NRA),
4. inquiry-based, learner-centered instruction such as project- or problem-based learning (PBL) where students are engaged in authentic, ill-structured, complex projects individually or collaboratively, and
5. multi-year mentoring (MYM), where students are advised by a mentor for multiple years rather than a single year teacher assignment.

In this framework, students, teachers, and parents create a PLP based on the unique needs, interests, and characteristics of the student and decide on learning goals and what projects to work on. PBL is used as the major instructional approach. While completing PBL, students master content on various related topics and take an ongoing criterion-referenced formative assessment to identify deficiencies and mastery. They move on to the next level or topic when mastery is reached, in contrast to when a fixed amount of time has passed. Students work with their primary teacher or mentor for multiple years to allow teachers to know them well to provide personalized support (Lee, 2014).

Based on the framework, we aim to answer the following research question. How do teachers in U.S. learner-centered schools practice PL in terms of PLP, CBSP, CRA, PBL, and MYM?

METHODS

A survey method was employed. Two important parts of the survey method are, as follows:

1. measurement of intended constructs and
2. representation of the target population (Groves et al., 2013).

All subjects provided appropriate informed consents and participated voluntarily, and the study was approved by the Institutional Review Board of the governing university (IRB Study #1208009370).

Measurement of Intended Constructs

To improve construct validity, the following steps were taken:

1. determined constructs and operational definitions based on a literature review,
2. developed survey instruments for desired constructs to identify important concepts to measure,
3. reviewed school websites to identify terminology used in the schools,
4. revised the survey instruments based on the objectives of the instruments, and
5. requested expert reviews and revised accordingly.

To ensure that respondents interpret the survey questions as intended, pre-tests were conducted utilizing a thinking-aloud protocol with four potential subjects who possessed K-12 teaching experience in the U.S. and were familiar with learner-centered instruction. Each subject was observed by two trained researchers. Follow-up questions were asked after the subjects completed the questionnaire. Issues related to organization, wording, additional options, and usability of the online questionnaire design were identified and addressed.

The five components of PL were measured. First, for a PLP, two instruments were developed to measure

1. how often aforementioned individual differences were considered when preparing a PLP, and
2. how often the plans were executed.

The two instruments used five-point Likert scales of frequency from never to always.

CBSP was measured on a five-point scale with an increment from complete time-based student progress (TBSP) (all together when a specified amount of time had passed) to complete individualized, attainment-based student progress (Individually as soon as each student mastered the current topic).

For CRA, teachers were asked

1. whether their major practice of assessment was criterion-referenced or norm-referenced, along with the definitions of each and the form of the assessment results, and
2. whether their student records were the mastery of individual competencies or traditional grades.

For PBL, seven items measured this construct:

1. how often they used such approaches on a 5-point scale from never to always,
2. whether students worked individually, in a small or large group, or by the entire class together,
3. how long a typical project lasted,
4. whether the nature of the inquiry was closed-ended or open-ended and whether the scope of the inquiry was uni-disciplinary or multi-disciplinary,
5. how authentic the inquiries were on a three-point scale from real-world inquiries, authentic but hypothetical inquiries, to hypothetical and not authentic inquiries,
6. how often students received instructional support or feedback during their projects on a 5-point scale,
7. what activities students engaged in during their project, and
8. how students were assessed.

For MYM, teachers were asked

1. how many consecutive years they typically stay with their students on a 5-point scale from one year to more than four years,
2. how many students they were able to build a close relationship with on a 5-point scale from none to all, and
3. whether each student got to choose one's primary teacher or not.

Representation of the Target Population

Our target population–teachers in learner-centered schools in the U.S.–was identified and purposefully selected based on the five criteria described in the conceptual framework. A sampling frame was identified by

1. identifying national school models of the learner-centered paradigm, such as Big Picture Learning schools, Carpe Diem schools, and EdVision schools, through a literature review and internet search,
2. visiting the 50 states' department-of-education websites and searching for such innovative programs and school districts, and
3. checking a list of learner-centered schools that an author of this report kept updating during the previous two decades because it provided the most comprehensive list of such schools that were available.

Schools that met the criterion of at least three out of the five components were included regardless of the school type–private, public, or charter. Exclusion criteria were

1. schools that had not implemented the features school-wide for more than one year in 2012, when the survey was administered,
2. special types of programs such as correctional facilities and after-school programs, and
3. preschools that served only pre-K to K grades.

As a result, 308 schools were identified.

Online questionnaires were distributed to the principals via email to be forwarded to their teachers, who could offer accurate information about their practice. To increase the response rate, several strategies were employed: personalizing invitations, mentioning scarcity of participants, sending multiple reminders, and providing participation benefits such as useful resources.

RESULTS

Response Rate and Nonresponse Bias

Among the 308 schools, principals' email addresses for 20 schools could not be identified, and email invitations failed to be delivered to seven schools. A total of 431 respondents from 72 schools responded to the survey, and 412 indicated their roles in their schools. Seventy-five (18%) respondents were administrators, 313 (76%) were teachers, and 24 (6%) assumed both roles. Finally, 41 schools provided 272 valid teacher responses to the questionnaires. Using the most conservative approach to calculate a response rate, the final response rate was calculated by dividing 41 by 308, yielding 13.3%.

The respondent and nonrespondent groups were not significantly different in terms of school type, $\chi(3)=4.685$, $p=.196$; location, $\chi(4)=2.275$, $p=.685$; the total number of students served, $t(263)=-0.657$, $p=.512$; and student-teacher ratio, $t(234)=1.052$, $p=.294$. However, the nonrespondent group ($M=59\%$, $SD=28\%$) served significantly more students who were eligible for the free or reduced lunch program than the respondent group ($M=42\%$, $SD=25\%$), $t(243)=3.229$, $p=.001$.

Personalized Learning Plan

Table 1 presents how often each of the factors was considered while creating PLPs. On average, students' characteristics, mastery levels, interests, and academic standards were often considered, but career goals were least considered. Interestingly, more than 50% of the respondents answered "never" to career goals taught in high schools. To the question about the implementation of PLPs, only 60% answered that they

Table 1. Frequency of students' factors considered in creating PLPs

Factors	Never (1)	Seldom (2)	Sometimes (3)	Often (4)	Always (5)	Total	Mean	SD
Characteristics	26	4	21	103	113	267	4.02	1.20
Mastery	27	6	37	93	105	268	3.91	1.23
Interests	28	6	36	96	101	267	3.88	1.24
Standards	33	12	31	79	113	268	3.85	1.34
Career goals	58	30	63	71	47	269	3.07	1.39

Table 2. Frequency of students' factors considered in creating PLPs

Answer	f	%
Altogether, when a specified amount of time had passed.	41	15
Altogether, when the entire class of students mastered.	24	9
By track when a group of students mastered.	35	13
Each project team when the team of students mastered.	18	7
Individually as soon as each student mastered.	154	57
Total	272	100

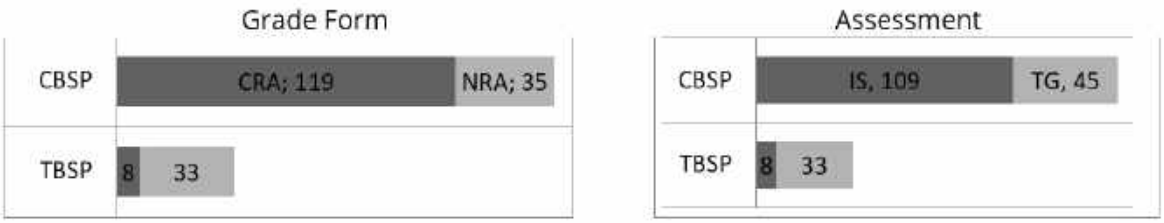

Figure 1. Comparison of grade form and assessment between CBSP and TBSP (Note. IS: Individual skills, TG: Traditional grades)

executed the PLPs often or always, and 21% responded that they never or seldom implemented the PLPs. Although about 90% of the respondents reported that they created PLPs with at least one factor such as characteristics, only 18% of teachers responded that PLPs were always implemented.

Competency-Based Student Progress & Criterion-Referenced Assessment

Among the 272 respondents, 57% answered that students moved on individually as soon as each mastered the current topic (CBSP), and 15% of teachers said that students moved on when a specified amount of time had passed (TBSP), as shown in **Table 2**. In total, 85% reported that they used some sort of CBSP rather than TBSP. This is higher than the survey findings by Gross et al. (2018). In the survey, about half of the teachers and 20-30% of students said they were in CBSP, and high school teachers were more reluctant to use CBSP than others.

Also, 57% of respondents kept students' academic records in the form of individual mastery or competency, and the remaining 43% still used traditional grades. As a major practice of assessment, 63% used CRA, and the remaining 37% used NRA. This is lower than the 81% of U.K. teachers who tracked academic mastery (Sebba & Britain, 2007).

Figure 1 compares grade form and major practice of assessment between the CBSP and TBSP groups. A majority of the CBSP group used CRA (77%) and kept student records as individual skills (71%), but there were still some who used NRA and traditional grades. In contrast, a majority of the TBSP group used NRA (80%) and traditional grades (80%).

Problem-Based Learning

Among the 243 respondents, only 7% reported that they never used PBL. The majority reported that they used PBL at least sometimes (85%). This is higher than the 69% of U.K teachers who reported using inquiry-based learning (Sebba & Britain, 2007). PBL was used in high schools more frequently than other grade levels and used almost equally in English language arts, mathematics, science, and social studies.

The respondents who at least rarely used PBL (n=225, 92%) reported that 52% of PBL projects were performed individually, followed by small groups (26%), and 32% of the projects lasted for 2-3 weeks, followed

Table 3. Student activities during PBL

PBL activities	Mean
Reflected on what they have learned	4.04
Presented their final products in class	3.99
Choose their own project topic	3.75
Self-monitored their progress	3.69
Decided on their roles & responsibilities	3.67
Decided on the process of their project	3.59
Set their own individual goals	3.50
Seer their own deadlines for each sub task	2.97
Shared their final product with community members	2.59

by about a month (25%). Most of the nature of inquiry was open-ended (96%), multi-disciplinary (75%), and real-world (72%), rather than authentic-but-hypothetical (23%), and hypothetical-and-not-authentic (4%).

In terms of instructional support and feedback, teacher coaching was the most frequently used instructional support (M=4.02), followed by peer coaching (M=3.31), teacher lecture (M=3.05), and computer-based instruction or web resources (M=2.99). Experts and community members were the least frequently used source of instructional support (M=2.34).

As shown in **Table 3**, the most frequently performed student activity during PBL was reflecting on what they had learned (M=4.04), followed by presenting their final product in class (M=3.99), choosing their own project topic (M=3.75), and deciding on their roles and responsibilities (M=3.67). The least frequently performed activity was sharing their final product with their community (M=2.59).

Students in learner-centered schools were more frequently engaged in self-regulation activities than students in regular schools (Gross et al., 2018), as indicated by selecting topics, setting their own goals, deciding on responsibilities, and monitoring their progress. These activities were also observed in some U.K. learner-centered schools (Underwood et al., 2007).

In contrast, setting their own deadlines was one of the least frequently performed activities. This is in line with the finding that giving students control over pace was one of the toughest transitions for teachers due to "the pressure to meet learning standards, worries about classroom management and uncertainty about students' self-direction" (p. 16). Interestingly, Underwood et al. (2007) found that disengaged students found self-regulating their learning process more difficult than liberating.

Among the 225 respondents who used PBL, 95% reported that the final product of the project was assessed. Individual academic performance (78%) and non-academic performance (75%) such as effort, work ethic, time management, communication, and collaboration, were also assessed frequently. Peer evaluation was utilized by about half of the respondents. Peer evaluation of their group members' personal performance was used by 49% of the respondents, and peer evaluation of other groups' final performance was used by 46%. Only 20% of the respondents reported that experts outside the school assessed the final project outcome.

Multi-Year Mentoring

Among the 226 respondents, 42% stayed with their students for one year only, and 58% of the respondents reported that they stayed with their students for at least two years or more. Among them, 11% reported that students could choose their primary teacher. To the question asking percentages of students with whom the teachers were able to build close relationships in their classrooms, 27% answered all, 39% answered about 75%, 20% answered about 50%, 13% answered about 25% (13.3%), and 0.4% answered none.

In total, 66% of teachers mentioned that they were able to build a close relationship with at least 75% of their students. This is comparable to the finding of the iNACOL survey that more than 50% of the teachers in regular schools understood the learning challenges and strengths of at least 75% of their students (Gross et al., 2018). In our survey, the percentage increased to 77% from 66% when teachers stayed with their students for more than one year.

As expected, 80% of the teachers who stayed with their students for one year indicated they could build a close relationship with only about 25% of the students, compared to 5% of the teachers who stayed for more than one year (MYM). Among the teachers within an MYM system, 77% indicated they could build a close

relationship with at least 75% of their students. The relationship between the number of years of teaching the same students and the percentage of students with whom they could build a close relationship was significant (ρ=.32, p<.001), which suggests a moderate positive relationship between the two according to the guideline of Cohen (1988). This empirically supports that the more years the teacher spends with students, the more students the teacher can build a close relationship with.

IMPLICATIONS, LIMITATIONS, and FUTURE RESEARCH

Implications

The survey results revealed several interesting aspects of PL practice in K-12 learner-centered schools. The results suggest that the majority of teachers in those schools implemented PL in support of the five features of PL (Lee, 2014); they created and implemented PLPs, allowed students to progress based on attainment of competencies, used inquiry-based approaches such as PBL, and stayed with the same students for at least two years (MYM).

Nevertheless, although those schools had practiced PL for years, it is noticeable that these features were practiced with different levels of implementation fidelity, defined as 'the degree to which teachers … implement programs as intended' (Dusenbury et al., 2003, p. 240). When research-based programs are translated into practice, implementation fidelity becomes critical to determining the quality of implementation (Breitenstein et al., 2010; Carroll et al., 2007; Dusenbury et al., 2003; Keller-Margulis, 2012). Specifically, Lillard (2012) argued that there is a strong positive association between implementation fidelity and student outcomes in Montessori education. Children in the program with high implementation fidelity showed significantly greater gains in executive function, reading, mathematics, vocabulary, and social problem-solving at the end of the academic year than their peers in other programs with low implementation fidelity (Lillard, 2012). Lee et al. (2021) also found that learner-centered schools that implemented PL more thoroughly generally performed higher in standardized tests than others.

Our findings uncover potential problems that regular schools may have while transitioning to PL. Students' career goals were not often considered when creating PLPs. A misalignment between student progress and assessment practice was found. There was a lack of community involvement during the PBL process. Teachers were not able to build a close relationship with all students. These problems seem to be residues from the transition from the teacher-centered to the learner-centered paradigm.

The learner-centered paradigm emphasizes that instructional decisions should be informed by the dual focuses

1. understanding of individual learners and
2. understanding about how learning best occurs (McCombs & Whisler, 1997).

Based on constructivism, we understand that learners should be engaged in personally meaningful, relevant, and authentic activities and diverse social interactions to be able to construct their own knowledge (Driscoll, 2005). Our findings suggest that

1. more effort should be made to get to know about individual learners and use the knowledge to help them make personal connections to learning,
2. more opportunities should be provided to interact and build relationships between the teacher and community members, and
3. assessment practice and the assessment system should be also transformed to better support PL instructional practice.

Based on the above implications, the following guidelines are suggested for educators wanting to implement PL. First, students' career goals can be better utilized when creating and implementing PLPs. Although much evidence supports the benefits of utilizing career goals in learning, career goals were least considered. Interestingly, more than 40% of teachers who never considered career goals taught high school students, who could greatly benefit from thinking about their career paths and being engaged in learning relevant to their career goals. Solberg et al. (2014) found that students whose learning plans were aligned with their career goals were more motivated to attend school and had less difficulty in choosing a career.

Career commitment or having career-related learning goals is known to be positively related to the transfer of knowledge and motivation to learn (Cheng & Ho, 2001), persistence in learning (Hull-Blanks et al., 2005), and long-term career success, especially for those with low socioeconomic status and little parental support (Tynkkynen et al., 2014).

Second, instructional and assessment practices should be aligned to better support PL. To enable CBSP, students' competency should be checked through CRA, and the assessment results should be kept as individual skills rather than final grades to inform teachers and students what each student has mastered and what to master next.

However, about 25% of the teachers who practiced CBSP did not use CRA as primary assessment practice and did not keep student records as individual skills. This misalignment could affect the efficiency or effectiveness of the student-progress system by failing to identify students' learning deficiencies and to document mastered skills at the granularity that can specifically inform learning and teaching as emphasized by numerous researchers and educational leaders (Lee, 2014; Patrick, 2011; Patrick et al., 2016b; Reigeluth, 2012). In the meta-analysis by Kulik et al. (1990), CBSP was significantly more effective than a conventional approach, with an effect size of 0.52, when a high standard of mastery was employed. Examining whether the students reached the high standard of mastery requires assessing knowledge at a finer level, which demands CRA and keeping records as individual skills instead of traditional grades.

Third, community involvement should be promoted while implementing the PBL. Based on 20 years of empirical evidence, Ainscow et al. (2012) argued that linking schools with their communities is one of the critical conditions for improving schools and achieving equity in education. In our survey, while PBL was widely used with real-world or authentic inquiries, there was a lack of involvement from the community or experts during the learning process. Instructional support from experts or community was seldom provided, and students' final products were rarely shared with the community or evaluated by external experts. Having students interact with community members or subject experts or sharing their final products could benefit students in many ways by engaging in dialogue with professionals about the subject matter, encouraging students to take their learning more seriously, and sparking their interests and curiosities.

Community involvement can lead to several benefits, including improving engagement and preventing chronic absenteeism (Epstein & Sheldon, 2002), increasing aspirations for higher education, grade point averages, academic self-esteem, intrinsic motivation toward schoolwork, and intrinsic work values (Johnson et al., 1998), and engaging students in more critical reflection by allowing them to integrate new knowledge into practice (Hong, 2016). Also, having students work on local community issues and engage in dialogue with community members can pave the way to linking schools with their wider communities and making PBL authentic and meaningful (Gross et al., 2018).

Lastly, teachers should be encouraged to build close relationships with students. Despite the importance, only 27% of teachers answered that they were able to build close relationships with all students in their classrooms. Building close relationships with students is fundamental to getting to know individual students and personalizing learning experiences for each of them (Burke, 1996; George et al., 1987). As seen in Project FAST (Families Are Students and Teachers), positive student outcomes in reading and mathematics were produced when teachers, parents, and students built close relationships and constantly engaged in conversations regarding student learning (Hampton et al., 1997; Hampton et al., 1998).

Limitations

Limitations exist in the study. Although a substantial effort was made to increase construct validity and minimize measurement errors, fundamental issues of using survey data still exist. The data were self-reported, and accordingly, some level of validity issues, measurement errors, and response errors should be expected.

Also, although there was no serious response bias found between the nonrespondent and respondent groups, the response rate was not high, and the sample size was small, which may limit the generalizability of the study findings. Furthermore, this study was conducted with schools in the United States, and the findings should not be generalized to other cultural contexts.

Future Research

PL is nationally and internationally promoted as a promising way to reform education. Our survey results from learner-centered schools revealed that paradigm change demands continuous effort to transform all aspects of the educational system. Research supports that PL should be implemented thoroughly to be effective (Han et al., 2014; Kulik et al., 1990; Lee et al., 2021; Wirkala & Kuhn, 2011), yet teachers are having difficulties in envisioning PL in their classrooms (Gross et al., 2018), and there is a paucity of research that informs the design and implementation of PL in K-12 classrooms (Li & Wong, 2021; Walkington & Bernacki, 2020).

Therefore, future research should be directed to inform PL practice. Specifically, research efforts should be directed to shed light on

1. how PL can be effectively designed in classrooms,
2. how schools and educational systems should be restructured to support PL practice, and
3. what support should be provided for teachers, schools, and school districts to make the transition smoothly and successfully.

Author contributions: DL: designed the study and led data collection and analysis process and was responsible for most of the write-up; **YH:** participated in the study design collectively, mainly worked for data collection and analysis, and a part of the write-up; **C-YL:** participated in the study design collectively and helped with the data collection; & **CMR:** oversaw the study design and consulted with the interpretation of the results as well as implications. All authors approve the final version of the article.

Funding: The authors received no financial support for the research and/or authorship of this article.

Declaration of interest: Authors declare no competing interest.

Data availability: The data generated and/or analyzed during the current study are not publicly available due to the conditions listed in the IRB but are available from the corresponding author on reasonable request.

REFERENCES

Ainscow, M., Dyson, A., Goldrick, S., & West, M. (2012). Making schools effective for all: Rethinking the task. *School Leadership & Management, 32*(3), 197-213. https://doi.org/10.1080/13632434.2012.669648

American Psychological Association Presidential Task Force on Psychology in Education. (1993). *Learner-centered psychological principles: Guidelines for school redesign and reform*. https://eric.ed.gov/?id=ED371994

Bernacki, M. L., Greene, M. J., & Lobczowski, N. G. (2021). A systematic review of research on personalized learning: Personalized 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

Bloom, B. S. (1968). Learning for mastery. *Instructions and Curriculum, 1*(2), 1-10.

Breitenstein, S. M., Gross, D., Garvey, C. A., Hill, C., Fogg, L., & Resnick, B. (2010). Implementation fidelity in community-based interventions. *Research in Nursing & Health, 33*(2), 164-173. https://doi.org/10.1002/nur.20373

Burke, D. L. (1996). Multi-year teacher/student relationships are a long-overdue arrangement. *Phi Delta Kappan, 77*(5), 360-361. https://www.proquest.com/scholarly-journals/multi-year-teacher-student-relationships-are-long/docview/218490646/se-2

Carroll, C., Patterson, M., Wood, S., Booth, A., Rick, J., & Balain, S. (2007). A conceptual framework for implementation fidelity. *Implementation Science, 2*(1), 40. https://doi.org/10.1186/1748-5908-2-40

Carroll, J. B. (1963). A model of school learning. *Teachers College Record, 64*(8), 723-733. https://doi.org/10.1177/016146816306400801

Cheng, E. W. L., & Ho, D. C. K. (2001). The influence of job and career attitudes on learning motivation and transfer. *Career Development International, 6*(1), 20-28. https://doi.org/doi:10.1108/13620430110381007

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Lawrence Erlbaum.

Department for Education and Skills. (2004). Department for Education and Skills: Five year strategy for children and learners. http://www.educationengland.org.uk/documents/pdfs/2004-five-year-strategy.pdf

Dewey, J. (1938). *Experience and education*. Kappa Delta Pi.

District Reform Support Network. (2016). *Transforming the culture of teaching and learning: Four race to the top-district grantees' implementation of personalized learning*. https://rttd.grads360.org/#communities/pdc/documents/12121

Driscoll, M. P. (2005). Constructivism. In M. P. Driscoll (Ed.), *Psychology of learning for instruction* (pp. 384-410). Allyn & Bacon.

Dusenbury, L., Brannigan, R., Falco, M., & Hansen, W. B. (2003). A review of research on fidelity of implementation: Implications for drug abuse prevention in school settings. *Health Education Research, 18*(2), 237-256. https://doi.org/10.1093/her/18.2.237

Epstein, J. L., & Sheldon, S. B. (2002). Present and accounted for improving student attendance through family and community involvement. *The Journal of Educational Research, 95*(5), 308-318. https://doi.org/10.1080/00220670209596604

George, P. S., Spreul, M., & Moorefield, J. (1987). Long-term teacher-student relationships: A middle school case study. *National Middle School Association*.

Gross, B., Tuchman, S., & Patrick, S. (2018). A national landscape scan of personalized learning in K-12 education in the United States. *iNACOL*. https://aurora-institute.org/wp-content/uploads/iNACOL_ANationalLandscapeScanOfPersonalizedLearning.pdf

Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2013). *Survey methodology*. John Wiley & Sons.

Hampton, F. M., Mumford, D., & Bond, L. (1997). Enhancing urban student achievement through multi-year assignment and family-oriented school practices. *ERS Spectrum, 15*(2), 7-15.

Hampton, F. M., Mumford, D. A., & Bond, L. (1998). Parent involvement in inner-city schools the project FAST extended family approach to success. *Urban Education, 33*(3), 410-427. https://doi.org/10.1177/0042085998033003006

Han, S., Capraro, R., & Capraro, M. M. (2014). How science, technology, engineering, and mathematics (STEM) project-based learning (PBL) affects high, middle, and low achievers differently: The impact of student factors on achievement. *International Journal of Science and Mathematics Education*, 1-25. https://doi.org/10.1007/s10763-014-9526-0

Henson, K. T. (2003). Foundations for learner-centered education: A knowledge base. *Education, 124*(1), 5-16.

Hong, J. (2016). Educational meaning of experiences of youth participation in community: Focused on activity in 'Youth Participation Committee'. *Ewha Women's University*. https://dspace.ewha.ac.kr/handle/2015.oak/214661

Hull-Blanks, E., Kurpius, S. E. R., Befort, C., Sollenberger, S., Nicpon, M. F., & Huser, L. (2005). Career goals and retention-related factors among college freshmen. *Journal of Career Development, 32*(1), 16-30. https://doi.org/doi:10.1177/0894845305277037

Johnson, M. K., Beebe, T., Mortimer, J. T., & Snyder, M. (1998). Volunteerism in adolescence: A process perspective. *Journal of Research on Adolescence, 8*(3), 309-332. https://doi.org/10.1207/s15327795jra0803_2

Keller-Margulis, M. A. (2012). Fidelity of implementation framework: A critical need for response to intervention models. *Psychology in the Schools, 49*(4), 342-352. https://doi.org/10.1002/pits.21602

Kulik, C.-L. C., Kulik, J. A., & Bangert-Drowns, R. L. (1990). Effectiveness of mastery learning programs: A meta-analysis. *Review of Educational Research, 60*(2), 265-299. https://doi.org/10.3102/00346543060002265

Lambert, N. M., & McCombs, B. L. (Eds.). (1998). *How students learn: Reforming schools through learner-centered education*. American Psychological Association. https://doi.org/10.1037/10258-000

LEAP Innovations. (2020). *LEAP learning framework for personalized learning: 2020 edition*. https://www.leapinnovations.org/leap-learning-framework/

Lee, D. (2014). How to personalize learning in K-12 schools: Five essential design features. *Educational Technology, 54*(2), 12-17. http://www.jstor.org/stable/44430266

Lee, D., Huh, Y., Lin, C.-Y., Reigeluth, C. M., & Lee, E. (2021). Differences in personalized learning practice and technology use in high- and low-performing learner-centered schools in the United States. *Educational Technology Research and Development, 69*(2), 1221-1245. https://doi.org/10.1007/s11423-021-09937-y

Li, K. C., & Wong, B. T.-M. (2019). How learning has been personalised: A review of literature from 2009 to 2018. In S. K. S. Cheung, L.-K. Lee, I. Simonova, T. Kozel, & L.-F. Kwok (Eds.), *Blended learning: Educational innovation for personalized learning* (pp. 72-81). Springer. https://doi.org/10.1007/978-3-030-21562-0_6

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

Lillard, A. S. (2012). Preschool children's development in classic Montessori, supplemented Montessori, and conventional programs. *Journal of School Psychology, 50*(3), 379-401. https://doi.org/10.1016/j.jsp.2012.01.001

McCombs, B. L. (2008). From one-size-fits-all to personalized learner-centered learning: The evidence. *The FM Duffy Reports, 13*(2), 1-12.

McCombs, B. L. (2013). The Learner-centered model: Implications for research approaches. In J. H. D. Cornelius-White, R. Motschnig-Pitrik, & M. Lux (Eds.), *Interdisciplinary handbook of the person-centered approach* (pp. 335-352). Springer. https://doi.org/10.1007/978-1-4614-7141-7_23

McCombs, B. L., & Whisler, J. S. (1997). *The learner-centered classroom and school: Strategies for increasing student motivation and achievement*. Jossey-Bass.

OECD. (2018). *OECD education 2030*. http://www.oecd.org/education/2030/

Patrick, S. (2011). New learning models: The evolution of online learning into innovative K-12 blended programs. *Educational Technology, 51*(6), 19-26. http://www.jstor.org/stable/44429967

Patrick, S., Worthen, M., Frost, D., & Gentz, S. (2016a). Meeting the Every Student Succeeds Act's promise: State policy to support personalized learning. *iNACOL*. https://files.eric.ed.gov/fulltext/ED590504.pdf

Patrick, S., Worthen, M., Frost, D., & Gentz, S. (2016b). Promising state policies for personalized learning. *iNACOL*. https://files.eric.ed.gov/fulltext/ED567893.pdf

Perkins, D. N. (1991). What constructivism demands of the learner. *Educational Technology, 31*(9), 19-21.

Reigeluth, C. M. (1987). The search for meaningful reform: A third-wave educational system. *Journal of Instructional Development, 10*(4), 3-14. https://doi.org/10.1007/BF02905306

Reigeluth, C. M. (2009). Instructional theory for education in the information age. In C. M. Reigeluth, & A. A. Carr-Chellman (Eds.), *Instructional-design theories and models: Building a common knowledge base* (pp. 387-399). Routledge. https://doi.org/10.4324/9780203872130

Reigeluth, C. M. (2012). Instructional theory and technology for the new paradigm of education. *Revista de Educación a Distancia* [*Distance Education Magazine*]*, 50*, 1.

Reigeluth, C. M., & Karnopp, J. (2020). *Vision and action: Reinventing schools through personalized competency-based education*. Marzano Resources.

Reigeluth, C. M., & Karnopp, J. R. (2013). *Reinventing schools: It's time to break the mold*. R&L Education.

Sebba, J., & Britain, G. (2007). *An investigation of personalized learning approaches used by schools*. DfES Publications.

Solberg, V. S., Wills, J., Redmon, K., & Skaff, L. (2014). Use of individualized learning plans as a promising practice for driving college and career efforts: Findings and recommendations from a multi-method, multi-study effort. *National Collaborative on Workforce Disability for Youth, Institute for Educational Leadership*. https://eric.ed.gov/?id=ED588651

Tynkkynen, L., Dietrich, J., & Salmela-Aro, K. (2014). Career goal-related success expectations across two educational transitions: A seven-year longitudinal study. *European Journal of Developmental Psychology, 11*(3), 356-372. https://doi.org/10.1080/17405629.2013.840577

U.S. Department of Education. (2010). Transforming American education: Learning powered by technology. *Office of Educational Technology*. https://www.ed.gov/sites/default/files/netp2010.pdf

Underwood, J., Baguley, T., Banyard, P., Coyne, E., Farrington-Flint, L., & Selwood, I. (2007). Impact 2007: Personalising learning with technology. *British Educational Communications and Technology Agency*. http://oro.open.ac.uk/34533/

Walkington, C., & Bernacki, M. L. (2020). Appraising research on personalized learning: Definitions, theoretical alignment, advancements, and future directions. *Journal of Research on Technology in Education, 52*(3), 235-252. https://doi.org/10.1080/15391523.2020.1747757

Watson, S. L., & Reigeluth, C. M. (2008). The learner-centered paradigm of education. *Educational Technology, 48*(5), 39-48. http://www.jstor.org/stable/44429608

Watson, W. R., & Watson, S. L. (2016). Principles for personalized instruction. In C. M. Reigeluth (Ed.), *Instructional-design theories and models* (pp. 109-136). Routledge. https://doi.org/10.4324/9781315795478-13

Wirkala, C., & Kuhn, D. (2011). Problem-based learning in K–12 education is it effective and how does it achieve its effects? *American Educational Research Journal, 48*(5), 1157-1186. https://doi.org/10.3102/0002831211419491

World Bank. (2019). World development report 2019: The changing nature of work. *The World Bank*. https://www.worldbank.org/en/publication/wdr2019

World Economic Forum. (2020). *The future of jobs*. http://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf

Zhang, L., Yang, S., & Carter, R. A. (2020). Personalized 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