



Core Research Topics of Studies on Personalized Feedback in the Past Four Decades

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Abstract. Assessment feedback is an essential part of learners' learning experiences. Personalized feedback in learning is a useful and common strategy for assisting learners to optimize their learning. With the increasing need to provide learners with high quality, immediate, and personalized feedback, a large number of studies had been conducted to investigate how to provide students with personalized feedback effectively. In this study, bibliometric analysis and word cloud techniques were applied to identify research trends and status related to personalized feedback in teaching and learning, based on 276 publications retrieved from the Web of Science database. To be specific, the data were analyzed in terms of annual numbers of publications and citations, important publication sources, countries/regions, and institutions, as well as important research issues and concerns. The findings of this study provided scholars as well as instructors with a general picture of the personalized feedback research.

Keywords: Personalized feedback · Bibliometric analysis · Word cloud

1 Introduction

Feedback refers to specific information concerning a learners' performance regarding a defined standard, given with intention for performance improvement [1]. Formative feedback is important for teaching and learning, especially for online programs. For a great number of courses, feedbacks are given by instructors, demanding high quality in content and process, particularly in introductory and basically procedural courses. Feedback may assume various forms, and the effectiveness and appropriacy of various feedback approaches differ [2]. Feedback is an essential component of assessment in learning contexts, enabling learners to monitor progress in the learning process, and helping instructors to provide personalized learning materials based on learners' profiles

[3]. With the increasing popularity of personalized learning (e.g., [4–7]), personalized feedback has become increasingly important [8].

A growing number of automatic models allow making inferences about learners' understanding according to their problem-solving choices, with various applications such as personalized feedback interventions in interactive educational contexts [9]. Studies had suggested that automated, computer-generated feedback allowed addressing learners' need for receiving feedback, as well as instructors' need to offer useful feedback efficiently [10]. Personalized feedback allows transforming self-assessment experience into learners' learning experience [3], and the personalization of feedback has become an essential research issue in electronic learning systems. Scholars have illustrated that the merits of computer-generated feedback were personalized and teacher-generated [10, 11], and highlighted that electronic feedback was more effective as compared to traditional methods [12].

Scholars have been devoting to research on feedback to allow self-assessment by using information generated during the learning process and further to offer personalized feedback to individual learners [3]. Currently, no review has been conducted in this field. To that end, this study aimed to explore research status and trends of personalized feedback using bibliometric analysis and word cloud technique. As effective and useful methods in mapping academic literature, bibliometrics and word cloud have been popularly adopted in many fields of research [13–18]. Based on 276 publications retrieved from Web of Science database, we analyzed the annual numbers of publications and citations, relevant publication sources, countries/regions, and institutions, as well as essential research issues and concerns.

2 Data and Methods

Figure 1 shows the workflow of data collection and analysis, including steps of data retrieval, data restriction, manual screening, and data analysis. The data retrieval was carried out in Web of Science database on February 26, 2020, with a search query written as TS = ((“personalized” OR “personalised” OR “personalisation” OR “personalization” OR “personalizing” OR “personalising”) AND “feedback”). The initial search returned 3,294 publications. The data were further narrowed down using the following restrictions to make sure that the publications were: 1) written in English, 2) research articles or conference papers, and 3) Education and Educational research. In this way, 385 publications were selected. Two domain experts then screened the 385 publications manually to ensure that they were closely related to personalized feedback for teaching and learning purposes, with irrelevant ones being excluded, including: 1) reviews ($n = 12$), 2) irrelevant to teaching and learning ($n = 17$), 3) surveys ($n = 5$), 4) irrelevant to personalized feedback ($n = 70$), and 5) published in 2020 ($n = 5$). After screening, 267 publications remained for data analysis.

To explore the annual trends of publications and citations, we carried out polynomial regression analyses with *year* as independent variable x . Analyses of important publication sources, countries/regions, as well as institutions, were conducted based on several bibliometric indicators, including publication count, citation count, average citations per publication, as well as Hirsh index (H-index) [19]. As for the analysis of research topics, key phrases extracted from the title and abstract of each publication were utilized. After pre-processing, as suggested by Chen et al. [13], the key phrases were analyzed using word cloud technique using R package *wordcloud2*. Three consecutive time periods were used to explore the evolution of essential phrases, including 1981–2004 (11 publications), 2005–2014 (114 publications), and 2015–2019 (151 publications).

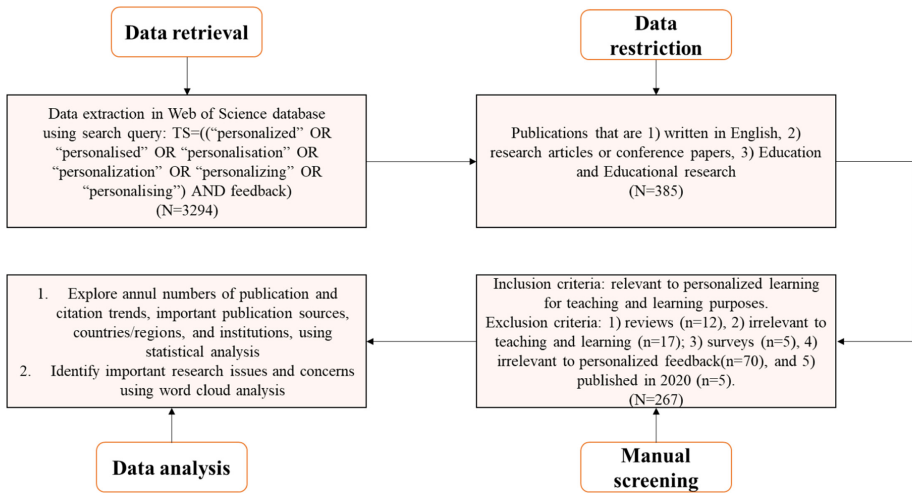


Fig. 1. The workflow of data collection and analysis

3 Results and Discussions

3.1 Trends of Publications and Citations

The trends of personalized feedback publications and the citations they received are depicted in Fig. 2, together with their polynomial regression curves. From the results, it was clear that for both the citations and publications, significantly increasing trends were shown. The results could also be indicated from the two regression models with positive coefficients of x^2 . With the two estimated models, predictive values for future years could be estimated. For example, the predictive values for the year 2020 in terms of the publication and citation counts were calculated as $0.04455176 \cdot 2020^2 - 177.4491 \cdot 2020 + 176692.7 = 34.4123$ and $0.3285617 \cdot 2020^2 - 1309.215 \cdot 2020 + 1304186 = 234.904$. In a word, the trends and the regression modeling results demonstrated a growing interest in the research on personalized feedback for teaching and learning, which is an increasingly important and impactful field of research.

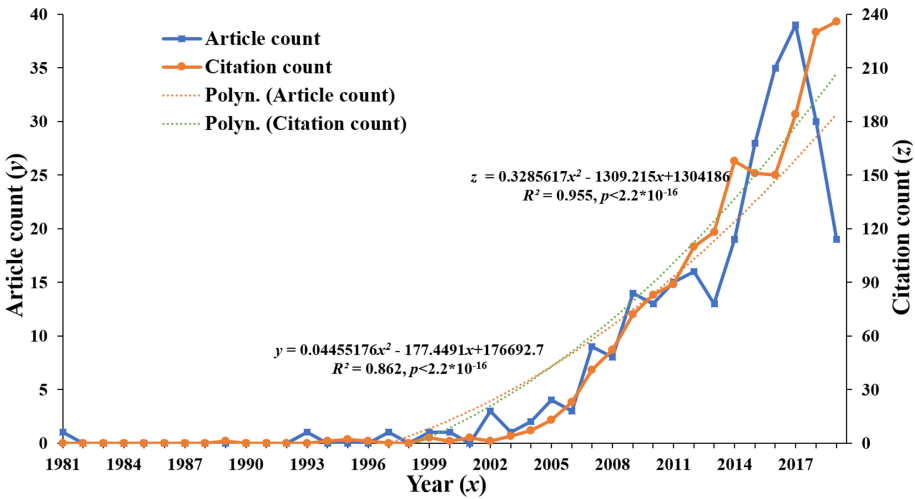


Fig. 2. Trends of publications and citations

3.2 Important Publication Sources, Countries/Regions and Institutions

The 276 publications were distributed in 106 sources of publications, among which the top nine measured by productivity are shown in Table 1. They together accounted for 40.22% of the total publications. *International Conference on Education and New Learning Technologies* was the most productive in publishing personalized feedback studies (32 publications). However, its H-index value was relatively low. Comparatively, *Educational Technology & Society* and *Academic Medicine*, although with fewer publications, were the most impactful in the field. In addition, it was noteworthy that although the top six listed in the table were all conferences, they had relatively lower H-index values. Thus, we might conclude that research articles in the field of personalized feedback were more impactful than conference papers.

Table 1. Top publication sources

Publication sources	1981–2019			1981–2004		2005–2014		2015–2019	
	A	C	H	A	C	A	C	A	C
International Conference on Education and New Learning Technologies	32	6	1	0	0	13	0	19	6
International Conference of Education, Research and Innovation	21	4	1	0	0	8	1	13	3
International Technology, Education and Development Conference	14	5	1	0	0	7	0	7	5
European Conference on E-learning	9	8	2	0	0	9	3	0	5
Frontiers in Education Conference	9	0	0	0	0	3	0	6	0
European Conference on Games Based Learning	8	9	2	0	0	5	1	3	8
Academic Medicine	6	221	4	0	0	3	159	3	62
Educational Technology & Society	6	109	4	0	0	3	58	3	51
International Conference on E-learning	6	5	1	0	0	4	0	2	5

Abbreviations: H: H-index; A: publication count; C: citation count.

A total of 58 countries/regions had contributed to the 276 publications. Table 2 lists the top ten prolific countries/regions, among which the USA was ranked the first as measured by publication count, citation count, and H-index (62 publications, 684 citations, and an H-index of 11). Using the measure of average citations per publication (ACP), it was noteworthy that although with relatively fewer publications, Taiwan was ranked at the top with an ACP value of 38.78. This indicated the broad influence of Taiwan's publications in personalized feedback.

Table 2. Top countries/regions

Countries/regions	1981–2019				1981–2004		2005–2014		2015–2019	
	A	C	ACP	H	A	C	A	C	A	C
USA	62	684	11.03	11	6	14	25	360	31	310
UK	42	165	3.93	8	1	5	20	29	21	131
China	22	23	1.05	3	0	0	5	1	17	22
Spain	22	13	0.59	2	0	0	12	1	10	12
Romania	15	18	1.20	2	0	0	6	8	9	10
Australia	13	71	5.46	5	2	2	3	6	8	63
Canada	12	145	12.08	6	1	2	7	52	4	91
Greece	10	40	4.00	3	0	0	8	24	2	16
India	9	52	5.78	2	0	0	3	7	6	45
Taiwan	9	349	38.78	6	0	0	5	191	4	158

Abbreviations: H: H-index; A: publication count; C: citation count; ACP: citation count per publication.

A total of 325 institutions had contributed to the 276 publications. Table 3 lists the top eight prolific institutions, among which *University of Barcelona* was the top one in terms of publication count. However, its citation count and H-index value were relatively lower, particularly as compared to *Athabasca University* (5 publications, 78 citations, and an H-index of 4). From the perspective of ACP, *Athabasca University* was ranked at the top one (15.60). Taking into account of all the indicators, we concluded that *Athabasca University* could be regarded as the top contributor to the research on personalized feedback, particularly in terms of research impact and influence.

Table 3. Top institutions

Institutions	Countries/regions	1981–2019				1981–2004		2005–2014		2015–2019	
		A	C	H	ACP	A	C	A	C	A	C
University of Barcelona	Spain	6	2	1	0.33	0	0	4	0	2	2
Athabasca University	Canada	5	78	4	15.60	0	0	3	20	2	58
University Politehnica of Bucharest	Romania	5	1	1	0.20	0	0	1	0	4	1
The Bucharest University of Economic Studies	Romania	4	11	1	2.75	0	0	1	6	3	5
The Open University	UK	4	15	1	3.75	0	0	1	0	3	15
University of Leeds	UK	4	52	2	13.00	0	0	3	11	1	41
Universitat Oberta de Catalunya	Spain	4	3	1	0.75	0	0	3	0	1	3
University of Sydney	Australia	4	18	2	4.50	0	0	1	0	3	18

Abbreviations: H: H-index; A: publication count; C: citation count; ACP: citation count per publication.

3.3 Important Research Topics

Table 4 lists the top 15 frequently used phrases in personalized feedback studies, among which “personalized feedback (appearing in 54 publications, accounting for 19.57%)” ranked at the first, followed by “learning process (46, 16.67%),” “personalized learning (29, 10.52%),” “learning experience (26, 9.42%),” “learning outcome (21, 7.61%),” “online learning (19, 6.88%),” and “virtual learning environment (19, 6.88%).” From the evolutions of the important issues for the three periods, as shown in both Table 4 and Fig. 3, some research issues had become increasingly concerned by scholars. First, several issues had been studied more over time, for example, “learning process,” “personalized learning,” “online learning,” “formative assessment,” “personalized feedback,” and “learning environment.” Second, there were several issues emerged in the latter two periods, for example, “learning experience,” “learning outcome,” “virtual learning

environment,” “case study,” “e-learning system,” “learning activity,” “learning management system,” and “learning system.” In addition, “learning analytics” appeared to be important in the last period, indicating its wide and popular application in personalized feedback research.

Table 4. Top frequently used phrases

Key phases	1981–2019		1981–2004		2005–2014		2015–2019	
	A	%	A	%	A	%	A	%
Personalized feedback	54	19.57%	4	36.36%	23	20.18%	27	17.88%
Learning process	46	16.67%	1	9.09%	25	21.93%	20	13.25%
Personalized learning	29	10.51%	1	9.09%	8	7.02%	20	13.25%
Learning experience	26	9.42%	0	0.00%	12	10.53%	14	9.27%
Learning outcome	21	7.61%	0	0.00%	8	7.02%	13	8.61%
Online learning	19	6.88%	1	9.09%	6	5.26%	12	7.95%
Virtual learning environment	19	6.88%	0	0.00%	11	9.65%	8	5.30%
Formative assessment	17	6.16%	1	9.09%	7	6.14%	9	5.96%
Learning analytics	17	6.16%	0	0.00%	0	0.00%	17	11.26%
Case study	16	5.80%	0	0.00%	7	6.14%	9	5.96%
E-learning system	16	5.80%	0	0.00%	13	11.40%	3	1.99%
Learning activity	16	5.80%	0	0.00%	8	7.02%	8	5.30%
Learning environment	16	5.80%	1	9.09%	8	7.02%	7	4.64%
Learning management system	16	5.80%	0	0.00%	7	6.14%	9	5.96%
Learning system	16	5.80%	0	0.00%	8	7.02%	8	5.30%

Abbreviations: A: publication count; %: percentage of publications.

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