CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

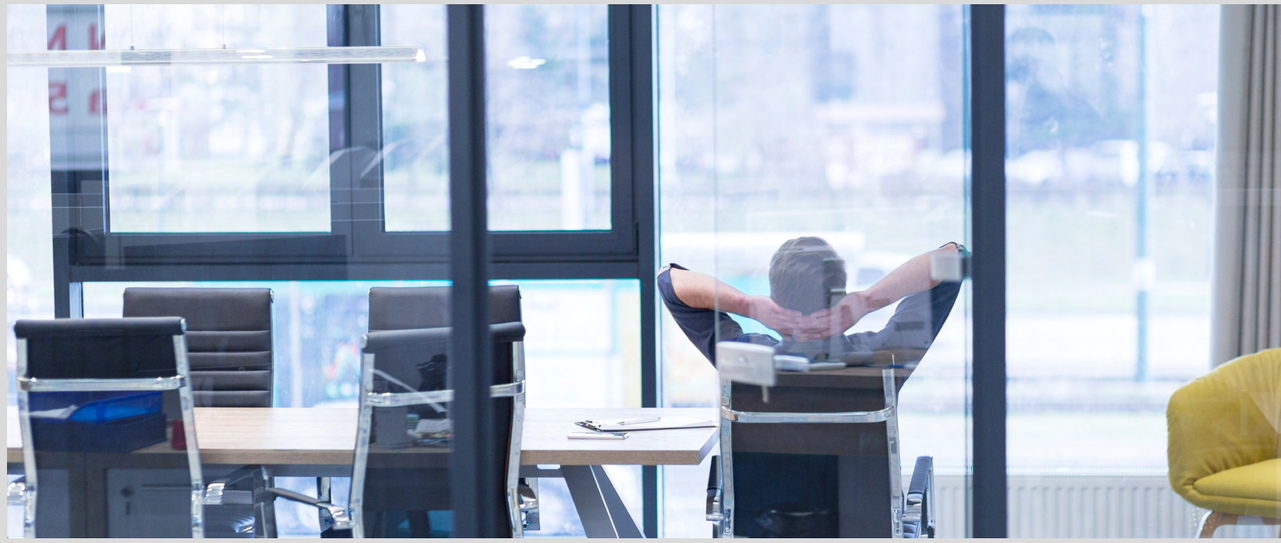
ERIES JOURNAL

JOURNAL ON EFFICIENCY AND RESPONSIBILITY IN EDUCATION AND SCIENCE

The ERIES Journal is being managed by an international editorial board as a regular scientific journal. A rigorous process of papers' reviews (double-blind peer review) is fully supported by a web-based submission system. The journal is published electronically four times a year, on March 31, June 30, September 30 and December 31 of the current year.

The journal is indexed in:

- BASE - Bielefeld Academic Search Engine
- Directory of Open Access Journals
- EBSCO database
- Emerging Sources Citation Index - Web of Science™ Core Collection
- ERIC - Education Resources Information Center
- ERIH PLUS
- Google Scholar
- Open Academic Journals Index
- ResearchBib
- SCOPUS
- The list of reviewed periodicals in the Czech Republic



www.eriesjournal.com

Scientific journal of the Czech University of Life Sciences Prague JOURNAL ON EFFICIENCY AND RESPONSIBILITY IN EDUCATION AND SCIENCE, distributed by the Faculty of Economics and Management. Published quarterly. Executive editors: Ing. Martin Flégl, Ph.D., Ing. Tereza Horáková, Ph.D. and Ing. Igor Krejčí, Ph.D., Editorial Office**:** ERIES Journal, Czech University of Life Sciences Prague, CZ 165 21 Prague 6 - Suchdol, Czech Republic, email: editor@eriesjournal.com, tel: +420 224 382 355.

volume 13
issue 3

2020

An international peer-reviewed journal published by
Faculty of Economics and Management
Czech University of Life Sciences Prague

editor@eriesjournal.com
www.eriesjournal.com
Online ISSN: 1803-1617
Printed ISSN: 2336-2375

EDITORIAL BOARD

EDITORIAL OFFICE

ERIES Journal, Czech University of Life Sciences Prague, CZ 165 21 Prague 6 - Suchdol, Czech Republic
email: editor@eriesjournal.com * tel: +420 224 382 355

Registration number: MK ČR E 21414

INSTRUCTIONS FOR AUTHORS

The Journal on Efficiency and Responsibility in Education and Science publishes papers of the following categories: full research papers, short communications, review studies and book reviews (on invitation only).

- FULL RESEARCH PAPERS
- SHORT COMMUNICATION
- REVIEW STUDY

Papers are published in English. A paper may comprise an empirical study using an acceptable research strategy, such as survey, case study, experiment, archival analysis, etc. It may contain a theoretical study aimed at advancing current theory or adapting theory to local conditions or it may arise from theoretical studies aimed at reviewing and/or synthesizing existing theory. Concepts and underlying principles should be emphasized, with enough background information to orient any reader who is not a specialist in the particular subject area.

Submission checklist

The paper. The paper is carefully formatted according to the template of the journal (see bellow). Special attention is paid to the exact application of the Harvard referencing convention to both continuous citations and list of references. If an electronic source has the DOI number assigned, also it will be provided in the list of references. Manuscripts are submitted via the editorial system in the DOC.

Research highlights. The core results, findings or conclusions of the paper are emphasized in 1-3 bullet points (max. 100 characters per bullet point including spaces). The highlights are submitted as a text into the submission form in the editorial system.

Copyright form. The submission of a paper will imply that, if accepted for publication, it will not be published elsewhere in the same form, in any language, without the consent of the Publisher. The manuscript submitted is accompanied by the copyright form signed by the corresponding author who declares the agreement of all authors with the conditions in the Form. The Form is submitted into the editorial system in the PDF format.

Suggested reviewers. It is required to suggest two experts appropriate to evaluation of the paper. The experts should be out of the affiliation of the author(s), Czech University of Life Sciences Prague, and also both experts should be from different affiliations. The reviewers are submitted into the text fields in the submission form of the editorial system.

Preparation of the manuscript (technical notes)

Authors are responsible for applying all requirements that are specified in the journal's paper template in individual sections. Especially, the paper must provide a short review of current state in the area of the paper's aim in Introduction. The paper should refer significant sources, particularly scientific journals or monographs.
Papers must be closely scrutinized for typographical and grammatical errors. If English is not author's first language then the paper should be proof-read by a native English-speaking person, preferably one with experience of writing for academic use. Spelling should follow the Oxford English Dictionary.
Tables, graphs and illustrations should be drawn using a suitable drawing package. Colour may be used. Place all diagrams and tables where you wish them to appear in the paper. Ensure your diagrams fit within the margins and are resizable without distortion.

Review procedure

Following Editorial recommendation, papers are submitted to a double-blind peer review process before publication. Commentary by reviewers will be summarized and sent by email to authors, who can choose to revise their papers in line with these remarks. Re-submitted papers should be accompanied by the description of the changes and other responses to reviewers' comments (see above), so that the desk-editor can easily see where changes have been made.

Copyright

Authors are fully responsible for the paper's originality and for correctness of its subject-matter, language and formal attributes. Author's statement should be enclosed declaring that the paper has not been published anywhere else.

The submission of a paper will imply that, if accepted for publication, it will not be published elsewhere in the same form, in any language, without the consent of the Publisher. Before publication, authors will be asked to complete a copyright release, giving the publisher permission to publish the paper in a specific issue of this Journal. Overall copyright ownership of the paper, however, remains with the author/s. It is the authors' responsibility to obtain written permission to quote material that has appeared in another publication.

We are glad to present you the third issue of the year 2020 (vol. 13, no. 3). We are pleased that ERIES Journal keeps attracting submission from different regions around the world. The current issue includes articles from collective of authors from The Republic of Kosova, Argentina, the Czech Republic, India, Turkey and the United Kingdom. The central topic of most of the late research is related to how to maintain a high quality of education in the current difficult times of the COVID-19 pandemic. As the majority of the economic activities around the world has been restricted, it is crucial managing efficiently the available resources. Similarly, many educational institutions had to alter their face-to-face education to its virtual form. In this case, the main issue is to secure that the virtual education does not negatively affect the given content to the students. There is no space for trial and error in education when you are in a position of a teacher. All processes must work without failures as the students' professional future depends on the learning outcome they receive. Teachers must be able to adjust their teaching to the virtual form, trying to incorporate uncommon teaching strategies that keep their classes attractive enhancing students' interests. This transition is smoother for those teachers that had used interactive materials before. On the other hand, those that had not used such materials may need support from their institutions.

In the first article "A Contemporary Approach to Managing Social Responsibility in Relation to Employees as Perceived in Academic Papers", Petra Jarkovská and Martina Jarkovská summarize the current "state-of-the-art" trends of the Corporate Social Responsibility in the Human Resource Management in academic literature. The authors analyzed in total of 67 articles published since 2009 until 2019 in Web of Science and Science Direct databases. The results revealed a positive causal relationship between the Corporate Social Responsibility and desirable employee behaviour, with job satisfaction often playing the function of a mediator in this process. What is more, the results also suggest that adding the Corporate Social Responsibility to the Human Resource Management practices could improve employees' work attitudes.

The second article "Effects of Teaching the Learning Psychology Course in Different Ways on the Student's Success and Attitudes" from Şeyma Şahin, Burcu Ökmen and Abdurrahman Kılıç determines the effect of teaching a learning psychology course in different ways on students' academic success and attitudes towards the course. The participants of the study were 265 students in the second year of a psychological counselling and guidance program in a state university in Turkey. The data were collected by Learning Psychology Course Achievement Test and student letters and the students were divided into three different learning groups. The results indicate that the flipped learning model is very effective on students' success. In this case, the students in the flipped learning group thought that group studies contributed to ideas exchanges with their friends, getting to know each other, and learning from each other.

In the third article "Unification of Multimedia with Techniques of Art and Vedic Aphorisms for Development of Mathematical Skills: A Study of Indian and UK School Students", authors Surinderjit Kaur Bawa, Rekha Kaushal and Jaswinder Kaur Dhillon describe the development of multimedia packages using techniques of art and Vedic aphorisms on some selected common topics of curriculum of the United Kingdom and Indian elementary mathematics, as well as the authors analyze the effectiveness of multimedia packages for the development of mathematical skills. The study was conducted using a quasi experimental design for research in both countries with a sample of 180 students divided equally between both countries. The authors found that the multimedia packages developed by using techniques of art and Vedic aphorisms have not been found to be effective in the development of mathematical skills of Indian elementary school students, whereas the significant effect on the development of mathematical skills was found in the case of the students in the United Kingdom. As the findings are not definite, the authors underline the need of further investigation of the subject.

In the fourth article "Higher Education Efficiency Frontier Analysis: A Review of Variables to Consider", Gustavo Ferro and Vanesa D'Elia elaborate a review of the literature on efficiency in higher education institutions by covering empirical articles which applied frontier efficiency measurement techniques from 1997 to 2019. More precisely, the authors review the methodological approaches used in both parametric and non-parametric techniques, such as Data Envelopment Analysis, Malmquist index and Stochastic Frontier Analysis. The list of the applied inputs, input prices, outputs, quality and environment variables was created. At the end, the authors discuss the advantages and drawbacks of the different empirical proxy variables used in the models, as well as the difference between quality and environmental variables.

Finally, the last article "Avoiding publishing in predatory journals: An evaluation algorithm" from Albana Berisha Qehaja overviews the gap in the knowledge of the scientific researchers regarding the journal selection to publish their work avoiding the predatory journals.

EDITORIAL

Nowadays, there are still many researchers who are unintentionally publishing in such journals, mainly due to the lack of information about such journals. Therefore, the main objective of the article is awareness-raising, warning, and guidance of scientific researchers, particularly young researchers by providing information on how to avoid submitting manuscripts to the predatory journals. To achieve this, the author consulted the recent literature and practices of different countries, summarized the most used tools/methods to identify predatory publishers and journals. As a consequence, the author describes a guiding algorithm for evaluating them.

To conclude this editorial, we would like to thank all authors who have submitted their articles to ERIES Journal and special thanks to all reviewers for their endless effort in revising the articles. As the ERIES Journal is indexed in the prestigious international databases, it is a commitment for us to constantly search for ways to improve the journal quality and its visibility. Thus, you can follow the latest updates related to the ERIES Journal on its LinkedIn page where we post information about the highest cited articles and related the upcoming events. We hope that all our readers will find this third issue of the year 2020 interesting.

Sincerely

Martin Flégl
Executive Editor
ERIES Journal
www.eriesjournal.com
www.linkedin.com/company/eriesjournal/
www.erie.pef.czu.cz

CONTENT

A Contemporary Approach to Managing Social Responsibility in Relation to Employees as Perceived in Academic Papers
Petra Jarkovská, Martina Jarkovská **101**

Effects of Teaching the Learning Psychology Course in Different Ways on the Student's Success and Attitudes
Şeyma Şahin, Burcu Ökmen, Abdurrahman Kılıç **113**

Unification of Multimedia with Techniques of Art and Vedic Aphorisms for Development of Mathematical Skills: A Study of Indian and UK School Students
Surinderjit Kaur Bawa, Rekha Kaushal, Jaswinder Kaur Dhillon **130**

Higher Education Efficiency Frontier Analysis: A Review of Variables to Consider
Gustavo Ferro, Vanesa D'Elia **140**

Avoiding publishing in predatory journals: An evaluation algorithm
Albana Berisha Qehaja **154**

A CONTEMPORARY APPROACH TO MANAGING SOCIAL RESPONSIBILITY IN RELATION TO EMPLOYEES AS PERCEIVED IN ACADEMIC PAPERS

Petra Jarkovská[1]✉
Martina Jarkovská[2]

[1]University of South Bohemia in České Budějovice, Czech Republic

[2]Czech University of Life Sciences Prague, Czech Republic

✉ pjarkovska@hotmail.com

ABSTRACT

Corporate Social Responsibility (CSR) plays a significant role in Human Resource Management (HRM), especially when it comes to stipulating desired employee performance or behaviour, such as work performance, job satisfaction, organizational commitment or retention. However, the academic literature offers very fragmented or partial answers to questions addressing this issue, as many scholars focus exclusively on e.g. one-country or one-industry based sample only. Therefore, the objective of this paper is to summarize the current "state-of-the-art" trends in academic literature and thereafter, based on the findings, propose a broader contemporary conceptual approach to managing CSR in relation to employees. The results suggest a positive causal relationship between CSR and desirable employee behaviour, with job satisfaction often playing the function of a mediator. The findings also suggest that adding CSR to HRM practices could improve employees' work attitudes. In doing so, full compatibility with other concepts and principles across the organization is a premise.

KEYWORDS

Corporate social responsibility, employees' needs, motivation factors, job satisfaction, retention

HOW TO CITE

Jarkovská P., Jarkovská M. (2020) 'A Contemporary Approach to Managing Social Responsibility in Relation to Employees as Perceived in Academic Papers', *Journal on Efficiency and Responsibility in Education and Science*, vol. 13, no. 3, pp. 101-112. http://dx.doi.org/10.7160/eriesj.2020.130301

Article history
Received
March 11, 2020
Received in revised form
May 21, 2020
Accepted
May 28, 2020
Available on-line
September 30, 2020

Highlights

- *Current academic findings regarding the CSR management and employees summarised.*
- *The relationship between CSR as a motivation driver and employee behaviour identified.*
- *A broader contemporary approach to CSR management in relation to employees provided.*

INTRODUCTION

Corporate Social Responsibility (CSR) can be understood as any decision of an organization that goes beyond its economic and technical interests (Carroll, 1991). The most commonly used and cited CSR concept (e.g. Bauman and Skitka, 2012; Farooq, Farooq and Jasimuddin, 2014; Kim, Song and Lee, 2016; Kim et al., 2017; Zhang, Oo and Lim, 2019) was first defined by Carroll (1991, 2015), who proposed a four-level CSR model including CSR economic, legal, ethical and discretionary (or philanthropic) levels (dimensions).

New ever-emerging concepts deal with the same or similar issues as CSR. Examples include Corporate Social Performance, Corporate Social Responsiveness, Corporate Citizenship and Corporate Governance (Carroll, 1991; Kim et al., 2017; John et al., 2019). Regarding sustainable economic performance, it is clear that current organizations must formulate and implement social goals and integrate ethical decisions into all their practices and activities. Ameer and Othman (2012) found that growth in economic performance indicators, e.g. sales and revenue, was higher in the 100 most sustainable organizations in the world than in control companies (CK, 2019). Concerning the organization's economic results, it is up to the managers to decide how to deal with the CSR concept in both the short and long term. Therefore, most authors consider the above concepts identical and interchangeable with the CSR concept (e.g. Carroll, 1991; Dahlsrud, 2008; Taneja, Taneja and Gupta, 2011; Kim et al., 2017; John et al., 2019).

According to CSR theory, an organization must satisfy different groups who would otherwise stop or cannot support the organization. The term "stakeholders" helps define and

simultaneously delimit the organization's responsibilities, which implies that the organization must engage in those CSR activities that its stakeholders consider important. Stakeholders may vary for each organization, but it is widely accepted that employees are the organization's key stakeholders. Their interest may be a legal claim, such as the fulfilment of contractual terms, a moral claim, such as employees' ability to express their opinion or organizations' fair behaviour towards employees (Carroll, 1991, 2015).

It becomes a challenge for each organization's management to address the urgency or importance of the demands made by different stakeholders. From a CSR viewpoint, the legitimacy of these claims is most important. Regarding organizational efficiency, the power of the relevant stakeholder group can have the greatest impact on the decision-making of the organization's management.

Theoretical background and the formulation of research questions

Carroll (1991) presents a conceptual approach to addressing the issue of conflict of interest of individual stakeholder groups and defines a series of questions that each manager should answer before taking appropriate action. Carroll's conceptual questions (1991: 44) are as follows:

- What opportunities and challenges do employees present to the organization?
- What social responsibility (economic, legal, ethical and philanthropic) should an organization have towards its employees?
- What strategies, practices or decisions should management undertake to best address their responsibilities and obligations to employees?

Work motivation is critical to employees' overall performance. Motivation affects what employees do, how they do it, and with what effort (Diller, 1999; Mayer, Becker and Vandenberghe, 2004; Kim et al., 2017; Graves, Sarkis and Gold, 2019). According to Graves, Sarkis and Gold (2019), many academics confirm the important role of individual CSR activities as motivating factors in meeting employees' needs and improving the quality of their working lives (QWL) (e.g. Cycyota, Ferrante and Schroeder, 2016; Kim et al., 2017; John et al., 2019).

Following Self-Categorization Theory (SCT), employees seek to integrate and become employees of organizations that are compatible with their values, enabling them to satisfy their psychological desires and meaningfully fulfil their existence (John et al., 2019). Likewise, Social Identity Theory (SIT) argues that if people have positive feelings for a group, they tend to identify themselves with the social status of the group, and membership in that group affects their self-esteem and pride (Dutton, Dukerich and Harquail, 1994; Maignan and Ferrell, 2001; Fu, Li and Duan, 2014; Kim et al., 2017).

At an organizational level, organizations seem to show better economic performance over the long term if more employees show a higher organizational commitment (OC) rate (Graves, Sarkis and Gold, 2019; John et al., 2019). This argument can be supported by Social Exchange Theory (SET); if one treats the other amicably, the other will repay him/her equally. Such behaviour is known as "limited" reciprocity (Peterson, 2004). The involvement of the organization in CSR activities can, therefore, significantly strengthen the employer-employee relationship and lead to job satisfaction (JS), increased work performance (WP) and OC, leading in turn to voluntary employee retention (R).

Based on the synergy of the above-described motivational theories (e.g. Maslow, 1943; Deci and Ryan, 1985, 2000), SCT, SIT and SET, we can define a causal relationship between CSR (a motivation factor) and employee behaviour as:

CSR → JS
CSR → WP
CSR → CO
CSR → R
CSR → JS →WP
CSR → JS → CO
CSR → CO → R
CSR → JS → CO → R

Therefore, Carroll's (1991) first, second and third question can be rephrased into three research questions (RQs) as follows:

- RQ 1: Which CSR dimensions affect employee satisfaction?
- RQ 2: How does CSR directly and indirectly affect employees' behaviour (JS, WP, OC, R)?
- RQ 3: What is the strength of the relationship between CSR and employee behaviour (JS, WP, OC, R)?

Macke and Genari (2019) mention a constant dilemma in Human Resource Management (HRM). On the one hand, Human Resources (HR) practitioners must support the efficiency of individual processes, such as reducing costs and increasing the organization's profitability, and, on the other hand, invest in human capital development and ensure its long-term sustainability and performance (Kramar, 2014; Macke and Genari, 2019). This paradox contributes to the tension between the goals set by the organization and the personal goals of employees (Aust, Brandl and Keegan, 2015). Incorporating CSR components and activities into HR practices can be one of the ways how to maintain JS, WP and R over the long-term (Celma, Martinez-Garcia and Raya, 2018).

As Ahmed and Rafiq (2002) state, the use of Internal Marketing (IM) practices such as segmentation, market research and marketing mix helps organizations motivate employees to meet organizational goals. Based on IM theories, employees can be considered internal customers, which leads to a positive influence on their behaviour and to improving their work results (Rafiq and Ahmed, 2000; Huang and Rundle-Thiele, 2014; Yao, Qiu and Wei, 2019). Key IM functions such as communication, education, development and employee motivation are important for increasing JS, R and subsequently strengthening employee loyalty to the employer (King and Grace, 2010; Wu, Tsai and Fu, 2013; Kim, Song and Lee, 2016; Yao, Qiu and Wei, 2019).

Within SIT, employees associate their own identity with the social identity of the organization they work for (Dutton, Dukerich and Harquail, 1994; Maignan and Ferrell, 2001; Kim et al., 2017). Employees working in socially responsible organizations are more likely to be happy and proud to be members of a "reputable" organization. They identify with and feel committed to the organization's goals (Fu, Li and Duan, 2014).

The above findings and social theories can be understood as theoretical bases and, therefore, Carroll's (1991) fourth question can be reformulated and broken down into the following three RQs:

- RQ 4: What HR practices can be used to support CSR?
- RQ 5: What IM tools can be used to support CSR?
- RQ 6: What CSR components and activities are used for building a good Employer Brand (EB)?

There seems to be a widening gap between theory and practice as organizations often fail to implement the new theoretical knowledge in practice. The reluctance to adopt the latest CSR concepts might be caused by the lack of theoretical knowledge on the one hand, or over-theoretical information on the other.

Our objective is to summarize the current trends in scientific knowledge and introduce a broader contemporary approach dealing with CSR management in regard to employees as one of the organization's stakeholders. We draw upon Carroll's (1991) concept using it as the baseline for the qualitative content analysis of "state-of-the-art" research papers on managing CSR in terms of employees.

The paper is structured as follows: In Introduction the current theoretical knowledge is summarized and the RQs are formulated. Material and Methods describe the procedure of selecting academic papers under analysis and the method of research. The obtained results are presented in subsections corresponding with the RQs. In Discussion the presented results are further elaborated and mutually compared, and a broader contemporary concept of CSR management in relation to employees is proposed. This part also identifies the benefits and limitations of this paper.

MATERIALS AND METHODS

Due to a very fragmented focus of each investigation, a narrative literature review (qualitative content analysis) and systematic literature review were considered the most suitable for summarizing the current trends and findings in the academic literature. Literature reviews provide a synthesis of published literature on a topic and describe its current state-of-art (Ferrari, 2015). While a narrative literature review is a comprehensive, critical and objective analysis of the current knowledge on a topic (Baker, 2016), a systematic literature review identifies, selects and critically appraises research to answer a clearly formulated question (Ferrari, 2015). The narrative review can address one or more questions and the selection criteria for inclusion of the articles may not be explicitly specified. Its quality may be improved by borrowing from the systematic review methodologies aimed at reducing bias in article selection and in employing an effective bibliographic research strategy (Ferrari, 2015).

For the systematic search, the instructions of Voegtlin and Greenwood (2016) and Macke and Genari (2019) were followed. In line with their proposals, six RQs were formulated. The selection criteria to identify the studies responding to the RQs were as follows: The studies were searched in the Web of Science and Science Direct databases. The search terms included combinations such as "CSR and employee motivation", "CSR and job satisfaction", "CSR and job performance", "CSR and labour productivity", "CSR and retention", "CSR and employee loyalty", "CSR and HRM", "CSR and HR practices", "CSR and IM", "CSR and Personnel Marketing" and "CSR and Employer Branding".

The searches were limited to peer-reviewed papers, papers written in English, and papers published from 2009 to fully reflect the current interests of employees. The original period was set at 5 years, i.e. papers published from 2014 till October 2019. Due to a low number of works found, the period was extended to a decade 2009-2019.

Analysing abstracts, article titles and keywords, works that did not meet all of the above criteria were excluded. Total number of selected articles (TC = 67), final number of articles excluding non-compliant papers (FN = 45), final number of articles based on empirical research (39), final number of articles based on a systematic literature review (6), final number of articles focusing on the relationship between CSR and employee behaviour (10), final number of articles dealing with the relationship between CSR and HR practices (10), final number of articles on CSR and EB (11) and final number of articles on CSR and IM (14).

The narrative literature review was used to analyze the current state of scientific knowledge of the causal relationship between CSR and employees as one of the organization's stakeholders. To avoid human factor bias, the review strategy and findings were consulted with two scholars. The analyzed papers were segmented as follows:

- *CSR and employee behaviour* (10): Bauman and Skitka (2012), Bohdanowicz and Zientara (2009), Farooq, Farooq and Jasimuddin, (2014), Graves, Sarkis and Gold (2019), Jakubczak and Gotowska (2015), John et al., (2019), Kim, Song and Lee (2016), Kim et al., (2017), Ong et al., (2018), and Youn, Lee and Lee (2018).
- *CSR and HR practices* (10): Celma, Martinez-Garcia and Coenders (2014), Celma, Martinez-Garcia and Raya (2018), Gully et al. (2013), Kim et al. (2010), Kramar (2014), Macke and Genari (2019), Stone and Deadrick (2015), Voegtlin and Greenwood (2016) and Zhang, Oo and Lim (2019).
- *CSR and EB* (11): Aggerholm, Andersen and Thomsen (2011), Ayshath Zaheera, Khan and Senthilkumar (2015), Carrico and Riemer (2011), Cycyota, Ferrante and Schroeder (2016), Dögl and Holtbrügge (2014), Fu, Li and Duan (2014), Gregory-Smith et al. (2015), Hagenbuch, Little and Lucas (2015), Jones, Willness and Madey (2014), Marler and Boudreau (2017), Puncheva-Michelotti, Hudson and Jin (2018) and Tkalac Verčič and Sinčić Ćorić (2018).
- *CSR and IM* (14): Chaudhary (2017), Chen and Cheng (2012), Dhanesh (2012), Duthler and Dhanesh (2018), Ferreira and de Oliviera (2014), Gill (2015), Gupta and Sharma (2016), Joung et al. (2015a, 2015b), Lim and Greenwood (2017), Ruizalba et al. (2014), Sanchez-

Hernandez and Grayson (2012), Soane et al. (2012) and Yao, Qiu and Wei (2019).

RESULTS

CSR and employee behaviour (RQs 1, 2, 3)

The studies confirm the positive causal relationship between CSR (economic, legal, ethical and philanthropic dimension) and employee behaviour (e.g. Bauman and Skitka, 2012; Kim, Song and Lee, 2016; Kim et al., 2017; Ong et al., 2018; Youn, Lee and Lee, 2018; John et al., 2019). In this context, employee behaviour is understood as JS, OC and R. The negative causal relationship was confirmed between CSR and employees' Turn over Intention (TI). Employee behaviour is sometimes used as a mediator to explain the indirect positive relationship between CSR and the employee behaviour resulting type. The most commonly used mediator is JS, which, based on motivational theories (e.g. Maslow, 1943; Deci and Ryan, 1985, 2000) explains the employee's interest in individual CSR aspects (e.g. Bauman and Skitka, 2012; Youn, Lee and Lee, 2018; Graves, Sarkis and Gold, 2019). Instead of the simple JS concept as a mediator between CSR and OC, Kim et al. (2017) use the QWL concept, defined as "employee satisfaction with meeting different needs through resources, activities and outcomes from participation in the work process" (Sirgy et al., 2001: 242). Based on Maslow's (1943) human needs hierarchy, the "lower-order" QWL includes employee satisfaction with the satisfaction of needs such as health, security and tangible needs through organizational resources. The "higher-level" QWL includes employee satisfaction with social and aesthetic needs, or with the need for respect, self-realization and self-education (again through organizational resources). This QWL construct undoubtedly assumes the importance of CSR in the organization. We arrived at a similar conclusion interpreting the findings of Franklin (2008) or Kim et al. (2017).

We can conclude that CSR organizational activities providing "tangible" care to employees (e.g. fair pay, family support and employment security) create desirable working conditions for employees, increasing the number of employees with a high QWL rate, leading in turn to increased employee loyalty and OC (Bohdanowicz and Zientara, 2009; Jakubczak and Gotowska, 2015; Kim, Song and Lee, 2016; Kim et al., 2017).

Even if CSR activities are not directly focused on employees, they still influence employee satisfaction with QWL. Especially the CSR ethical and philanthropic activities have the potential to meet higher-level employee needs. CSR activities that allow employees to make a meaningful contribution to addressing social issues appear critical to the higher-level QWL (Cycyota, Ferrante and Schroeder, 2016; Kim et al., 2017). This is confirmed by Graves, Sarkis and Gold (2019), who examined the impact of external and internal motivation (also Deci and Ryan, 1985, 2000) on employees' pro-environmental behaviour. Motivation based on employees' internal values or efforts to avoid guilt, has a positive impact on their pro-environmental behaviour. In contrast, external motivation has a negative impact but suggests that the use of employee incentives to increase pro-environmental behaviour may be unnecessary (Graves, Sarkis and Gold, 2019).

As Youn, Lee and Lee (2018) conclude, it is important how employees perceive the industry they work in. If they know the industry has little positive impact on the development and problem-solving of a community or society, the involvement of the organization in CSR activities does not affect JS and OC. For the organization, it is important to continuously improve employees' awareness about its CSR activities, e.g. through effective communication and employees' continuous training (Youn, Lee and Lee, 2018).

CSR and HRM practices (RQ 4)

Given the ever-changing conditions of the international business environment, employees' needs and well-being became the concern of many international organizations (Stone and Deadrick, 2015). In practice, socially responsible HRM principles are essentially defined by conventions, regulations and directives issued by various international institutions promoting CSR, such as the European Commission Green Paper (2001a) and other European Commission documents issued by the European Commission (2001b; 2002; 2011), the Global Compact programme (UN Global Compact, 2019), ISO 26000 (ISO, 2017), OECD Guidelines (OECD, 2018) and the accredited certification for social responsibility SA8000 (SAI, 2019). These documents do not offer an "exhaustive" list of socially responsible HRM practices but serve as recommendations or guidelines for national authorities and institutions (Celma, Martinez-Garcia and Coenders, 2014). For example, a socially responsible organization reduces the number of fixed-term jobs while guaranteeing job security, enabling employees to develop, or providing employees with fair pay for their work. An organization is socially responsible if it fights any form of workplace discrimination, enables employees to participate in its policies, and is committed to safety practices and performance measures (European Commission, 2001b; Celma, Martinez-Garcia and Coenders, 2014; Celma, Martinez-Garcia and Raya, 2018). Zhang, Oo and Lim (2019) regard various recommendations and regulations (whether internationally or nationally) as CSR "drivers", while their absence is seen as an "obstacle" to CSR implementation in business practice.

Voegtlin and Greenwood (2016) confirm the growing interest of academics in CSR and HRM relationship. 72% of all works on the CSR and HRM relationship were published between 2009 and 2014 (the research included works published from 1975 till 2014). Voegtlin and Greenwood (2016) also noted a shift from the perception of HRM as part of CSR or CSR as part of HRM, to the understanding of CSR and HRM as two interdependent and interconnected concepts.

The intersection between sustainable development and HRM is based on two assumptions: the HRM role in supporting the organization's sustainable development, and the long-term HRM practices sustainability. As organizations strive for sustainable development of their businesses, management practices should focus on creating a strategic advantage based on three factors: human capital, the environment and profitability (Macke and Genari, 2019). E.g. Macke and Genari (2019) developed an HRM model promoting sustainable business development through personnel practices such as talent management or employee knowledge and competence acquisition. This HRM model design (Macke and Genari, 2019: 812) is in line with other authors' findings (e.g. Kim et al., 2010; Gully et al., 2013; Celma, Martinez-Garcia and Raya, 2018; Zhang, Oo and Lim, 2019). The most effective and frequently cited HRM procedures contributing to consolidating CSR and vice-versa are: employee selection, employee motivation, fair remuneration and evaluation and employee development. For example, an organization can select new employees based on sharing common values with the employees and leveraging CSR practices to gain the best talents, as current job seekers increasingly value socially responsible employers (Voegtlin and Greenwood, 2016; Celma, Martinez-Garcia and Raya, 2018; Zhang, Oo and Lim, 2019).

CSR and IM practices (RQ 5)

Although the IM concept was introduced by many authors, Foreman and Money (1995) are considered the first to identify the three specific IM components and their measurement (Joung et al., 2015a, 2015b): vision ("something" that employees can trust), development (developing employees' competencies) and remuneration system (fair performance remuneration). Joung et al. (2015a) base their work on this concept (Foreman and Money, 1995) and supplement it with two additional components: employee motivation and internal communication. They understand employee motivation as the work itself and the satisfaction resulting from the acquired work experience (Deci and Ryan, 1985; Gagné and Deci, 2005). Internal communication, the fifth component of the IM concept, serves to support communication among employees themselves and between employees and the organization through internal and external channels (Chen and Cheng, 2012).

Many authors confirm a strong positive causal relationship between IM and JS. They also confirm that IM practices not only increase JS but also positively influence overall employee behaviour (e.g. Rafig and Ahmed, 2000; Ruizalba et al., 2014; Joung et al., 2015a; Kim, Song and Lee, 2016; Duthler and Dhanesh, 2018; Yao, Qiu and Wei, 2019). Key IM functions such as communication, education, development and employee motivation are important aspects increasing JS, R and subsequently strengthening employee loyalty to the employer (King and Grace, 2010; Wu, Tsai and Fu, 2013; Kim, Song and Lee, 2016; Yao, Qiu and Wei, 2019).

Sanchez-Hernandez and Grayson (2012) used a three-level IM model (Ahmed and Rafiq, 2002) to effectively implement a CSR strategy. The first level, "goals" (direction), requires setting goals and defining the direction in which the organization's effort is to be directed. This requires an evaluation of the organization's external opportunities and capabilities. This IM level is particularly important for raising CSR awareness among employees. The second level, "path", deals with the specification of alternative ways of implementing the CSR strategy and identifying potential obstacles and mechanisms to overcome them. At this level, specific programs should be developed for specific groups of employees. Using IM tools such as IM research or employee segmentation is an effective way to implement marketing strategies in practice. The third level, "action", is a "transition" from plans to actions. At this level, the aim is to develop a tactical measure package meeting employees' needs, i.e. an appropriate combination of differentiated benefits for specific employee segments motivating them to effectively implement a CSR strategy into the organization. Sanchez-Hernandez and Grayson (2012) understood the need to support CSR "from below". They added a fourth level to the adopted model, "feedback", representing e.g. voluntary employee initiatives. For the IM concept to be successful, Sanchez-Hernandez and Grayson (2012) suggested using marketing mix elements such as a job (education, level of responsibility, employee involvement in decision-making, etc.), labour value (employee income and costs for the work performed), communication (explaining and promoting the CSR strategy) and working environment (e.g. organizational culture, values, artefacts, etc.).

A well-established CSR strategy is essential for engaging employees in CSR activities (Gupta and Sharma, 2016; Chaudhary, 2017). For example, Soane et al. (2012) identified three dimensions of employee involvement: cognitive (intellectual), emotional (affective) and social (physical). According to Gill (2015), a higher level of employee engagement can be achieved through a managed narrative of CSR stories. Storytelling can be considered part of internal communication. Duthler and Dhanesh (2018) used Gill's (2015) link between CSR and employee engagement as a theoretical basis to combine the concept of internal communication, CSR and employee engagement. As for internal communication, they used a model designed by Morsing and Schulz (2006), which allows three ways of communication between an organization and employees: one-way communication to spread positive information about CSR strategy to workers and two-way asymmetric communication, useful when an organization requires employee feedback (e.g. CSR programme evaluation by employees). This feedback mostly serves to improve the current practices of the organization only, not to listen to employees. And above all, two-way symmetric communication based on a dialogue between the organization and employees. Duthler and Dhanesh (2018) demonstrate a positive causal relationship between all CSR dimensions and employee engagement at all three levels (cognitive, emotional and social). Although the study confirmed the positive causal relationship between all CSR dimensions and all engagement levels, the CSR social and environmental aspects had the strongest positive impact on the emotional and social link among employees, and between employees and the organization, even though employees rated the economic dimension the highest. This is inconsistent with the results of other studies. For example, some authors confirm that employees exposed to internal CSR practices are more involved than those exposed to external CSR activities only (Ferreira and de Oliveira, 2014; Gupta and Sharma, 2016). Similarly, Dhanesh (2018) found that although all CSR levels have a positive impact on employee OC, it is primarily the ethical and legal dimensions of CSR that have the strongest impact on OC and employee loyalty. Following Duthler and Dhanesh (2018), we can state that although organizations can use all three ways of communicating with employees, for the organization it is especially important to develop two-way symmetric communication to meet all its objectives successfully (Lim and Greenwood, 2017).

Increased employee engagement and satisfaction leads to increased employee loyalty to the organization (Yao, Qiu and

Wei, 2019). Regarding marketing theories (Zhang et al., 2014; Yao, Qiu and Wei, 2019), customer loyalty has two dimensions: loyalty based on customer attitude to a product or brand, and behavioural dimension (e.g. re-purchase). Yao, Qiu and Wei (2019) used a marketing approach to loyalty and, based on the results of empirical research, confirmed a positive causal relationship between JS and OC (affective and behavioural) to the organization. While affective loyalty is always conditioned by JS, behavioural loyalty may not be. The findings also point to a different influence of both loyalty dimensions on OC. Only behavioural loyalty leads to OC, regardless of JS and changing conditions. The results are consistent with marketing research findings which claim that satisfied customers do not necessarily re-purchase the same product (Zhang et al., 2014; Yao, Qiu and Wei, 2019).

CSR and EB (RQ 6)

The EB represents the overall benefits that an organization offers to its employees to improve attractiveness as an employer for existing and future employees (Tkalac Verčič and Sinčić Ćorić, 2018). Today, EB management is increasingly seen as an integral part of an organization's sustainability strategy (Aggerholm, Andersen and Thomsen, 2011). Research into the relationship between CSR and EB suggests that an organization's involvement in the organization's philanthropic activities or environmental performance (e.g. saving and recycling production resources) has a positive impact on the employer's attractiveness (Jones, Willness and Madey, 2014; Cycyota, Ferrante and Schroeder, 2016; Tkalac Verčič and Sinčić Ćorić, 2018). Organizations involved in solving social problems are better perceived by job seekers inferring organizations' behaviour towards employees from this fact (Dögl and Holtbrügge, 2014; Jones, Willness and Madey, 2014). The organization's expected behaviour towards employees or the organization's involvement in pro-environmental activities helps candidates assess the compatibility of the organization's values with their own (Jones, Willness and Madey, 2014; Tkalac Verčič and Sinčić Ćorić, 2018).

However, not all CSR activities are received positively. Potential employees perceive organizations pursuing both financial and social interests simultaneously with suspicion, as these goals may appear incompatible with their own. Employees associate the organization's economic goals with their economic interests, but they perceive them as less noble; while e.g. the organization's philanthropic activities such as volunteering appeal to job seekers' moral values (Hagenbuch, Little and Lucas, 2015). According to Hagenbuch, Little and Lucas (2015), employees prefer to participate in the organization's socially responsible activities for purely altruistic reasons. They do not want to be associated with CSR activities bringing them economic benefits (conditional altruism). According to Tkalac Verčič and Sinčić Ćorić (2018) and Jones, Willness and Madey (2014), these findings are consistent with theoretical bases such as signalling theory and SIT, and play an important role in recruitment and R. Based on the CSR analysis of Fortune's 100 Best Companies to Work for in the United States, Cycyota, Ferrante and Schroeder (2016) found that the organizations occupying the second half of the ranking placed more emphasis on volunteering and philanthropic activities than organizations occupying the first half. This can be explained by the negative experience of many organizations in engaging employees in socially responsible activities (Carrico and Riemer, 2011; Gregory-Smith et al., 2015). The results of an online career adverts content analysis also indicate limited (e.g. limited to education and volunteering) or no promotion of CSR activities, even for organizations with the reputation of socially responsible employers. For most employers, this means random practices without any continuity of presenting themselves as socially responsible employers (Puncheva-Michelotti, Hudson and Jin, 2018). According to Puncheva-Michelotti, Hudson and Jin(2018) and Ayshath Zaheera, Khan and Senthilkumar (2015), in the long term, the organization must adopt an appropriate strategic approach for socially responsible EB.

For example, to increase the attractiveness of an organization as an employer, it is important that the organization properly uses and combines different communication forms to communicate with potential employees. As a result of increasing reliance on social media and the Internet for information, online career opportunity advertising became a key recruitment tool, especially for Y-generation job seekers or highly skilled individuals (Marler and Boudreau, 2017). Organizations' socially responsible activities are essential for these two groups when choosing an employer. For the organization, it is important to appropriately incorporate a "CSR activities section" into the advertisement content and focus primarily on presenting the activities essential for the applicant target groups.

DISCUSSION

According to many academics (e.g. Youn, Lee and Lee, 2018; Yao, Qiu and Wei, 2019) dealing with causal relationships between various CSR dimensions and employee behaviour, most current works concentrate on the relationship between CSR and other organization stakeholders, e.g. owners or customers. Our research also confirms a low incidence of works on CSR and employees. Most works (supported by empirical quantitative research) concentrated on the tourism and lodging industry in the service sector, dependent on employee WP essential for building customer confidence and loyalty. Employees interact directly with customers and their performance is often the only way to differentiate among almost identical services (Youn, Lee and Lee, 2018). Moreover, the two above-mentioned industries are characterized by high staff turnover leading not only to weakened relations between the organization and employees but also to the organization's worse long-term economic situation. High employee turnover negatively affects the quality of services and customer satisfaction (Yao, Qiu and Wei, 2019).

Geographically, most research is located in Asia, which can be explained by a growing interest in the region as a tourist destination (Kim et al., 2015). Voegtlin and Greenwood (2016) also confirm an increased interest among academics in this world region (18% is almost identical to the percentage of research located in North America and Europe).

The studies confirm the positive causal relationship between individual CSR dimensions and employee behaviour. Employee behaviour is understood as JS, OC and R. Motivation theories, the signalling theory and SIT are most often used as theoretical bases to prove a direct or indirect CSR and employee behaviour causal relationship. In the case of the indirect relationship between CSR and employee ultimate behaviour, the JS concept is used as a mediator. Yao, Qiu and Wei (2019) utilize the loyalty concept from marketing theories and see loyalty as a "higher" form of OC. Based on marketing principles, they identified two dimensions of employee loyalty: affective and behavioural. To increase long-term R, it is necessary to "build" an employee and employer relationship on mutual trust, with behavioural loyalty conditioned by affective loyalty.

Synthesising individual results, we can deduce a positive causal relationship between CSR and increased R - the ultimate employee behaviour desired by an organization. This causal relationship can be described as follows:

V/N → CSR → JS → OC → R

where

V - represents values recognized by an employee, N - represents employee needs;

CSR - represents each CSR dimension that serves as a motivation factor;

JS - represents employee satisfaction with work;

OC - represents employee commitment to an organization and

R - represents employee retention.

Instead of using the JS concept, Kim et al. (2017) use a more comprehensive concept of satisfaction - QWL, including work-life balance. Celma, Martinez-Garcia and Raya (2018) use a three-level concept including JS, job stress and trust in management in place of the "simple" JS concept.

Although individual studies differ in the degree of relationship strength, it is not contrary to the theoretical background. This can be explained by the geographical, economic and industry differences and diversity of the population samples examined (e.g. age, gender, social status, education). For example, as a possible explanation for a strong positive relationship between the CSR philanthropic dimension and employee behaviour, Duthler and Dhanesh (2018) mention the Islamic culture prevailing in the sample. Works on EB focus mainly on the CSR environmental and philanthropic dimensions currently viewed as the main motivational factors (Maslow, 1943, Deci and Ryan, 1985, 2000, 2008) of qualified employees and Y-generation (e.g. Cycyota, Ferrante and Schroeder, 2016; Puncheva-Michelotti, Hudson and Jin, 2018). Although the content analysis shows the importance of these two CSR dimensions, the introduction of CSR philanthropic and environmental dimensions into the daily life of an organization does not make the organization socially responsible. It is primarily the ethical and legal dimensions (e.g. adherence to contractual terms, job security) that are pitfalls for many organizations in business practice. Similar conclusions were reached by Carroll (1991, 2016), who as a solution proposed the introduction of ethical management (Carroll, 1991, 2016). In practice this means e.g. introducing a management style leading to mutual respect, open dialogue and "fair" conduct. Unethical (immoral) management or, at best, amoral management, which can be understood as ethically neutral, are unacceptable to the society of the twenty-first century.

A proposed contemporary concept of CSR functioning as a motivation driver to stipulate desired employee behaviour by an organization

Based on the knowledge of the relationship between CSR individual dimensions and employee target behaviour - increased R (↑R), we propose a broader contemporary concept (see Figure 1) based on managing employee motivation through CSR aspects or attributes purposefully (through thorough employees' knowledge and constant monitoring of their changing needs) and comprehensively, using HRM, IM and EB practices effectively and "sustainably".

Thus, looking at the CSR dimensions (economic, legal, ethical, and philanthropic) through the lances of motivation theories, the signalling theory or SIT, different CSR activities and components such as competitive wages, health insurance coverage, full-time job opportunities, employee development or anti-discrimination policies have the potential to fulfil employees' need for safety and security, consequently leading to building employees' trust in the organization, enhancing OC (↑OC), increasing WP (↑WP) and voluntary R (↑R). Such activities enable the potential employees to view the organization as trustworthy and "secure to work for", making, in turn, the recruitment process easier and more successful.

Employees' need for a sense of belonging could be fulfilled by the organization's engagement in philanthropic activities, environment or community "positive impact" causes, or by organization's ethical adherence (e.g. values declaration or daily decision-making). The perceived similarity in "values fit" makes employees improve their work behaviour patterns (e.g. encourages ethical behaviour and decision-making, supports employees' responsibility and WP, increases OC and R). Philanthropic activities, responsible environmental stewardship and "well-deserved" reputation of high-quality products or services align with the employees' perception of how others view the organization and thus help serve the employees' need for distinctiveness. With gradually enhanced pride in organizational membership, OC and voluntary R, employees' recruitment is facilitated. Seemingly, the employees' need for meaningful existence could be undoubtedly attained by CSR activities or components. Perceived contribution to welfare or building a positive legacy by engaging in a community or social development, feelings of authenticity and self-actualization produce employees' life satisfaction and emotional well-being, improve task persistence and WP and contribute to OC, eventually leading to voluntary R.

The principles of effective and sustainable CSR (economic, legal, ethical and philanthropic dimensions) should be therefore incorporated and promoted by HRM, IM and EB practices to attract and retain talented employees, maintain physically and emotionally healthy employees and develop or improve their skills, expertise and knowledge. In compliance with our findings, we suggest the following HRM, IM and EB practices

as most suitable: regular labour market research, effective recruitment targeting, existing employee segmentation, staff development and talent management, the allocation of competencies, appropriate resources and responsibilities, a fair and transparent evaluation and remuneration system and two-way symmetric communication. This concept calls for HR practitioners and managers trained and skilled in human behaviour or psychology and highly sensitive to constant changes in both, the micro- and macro- level of the environment.

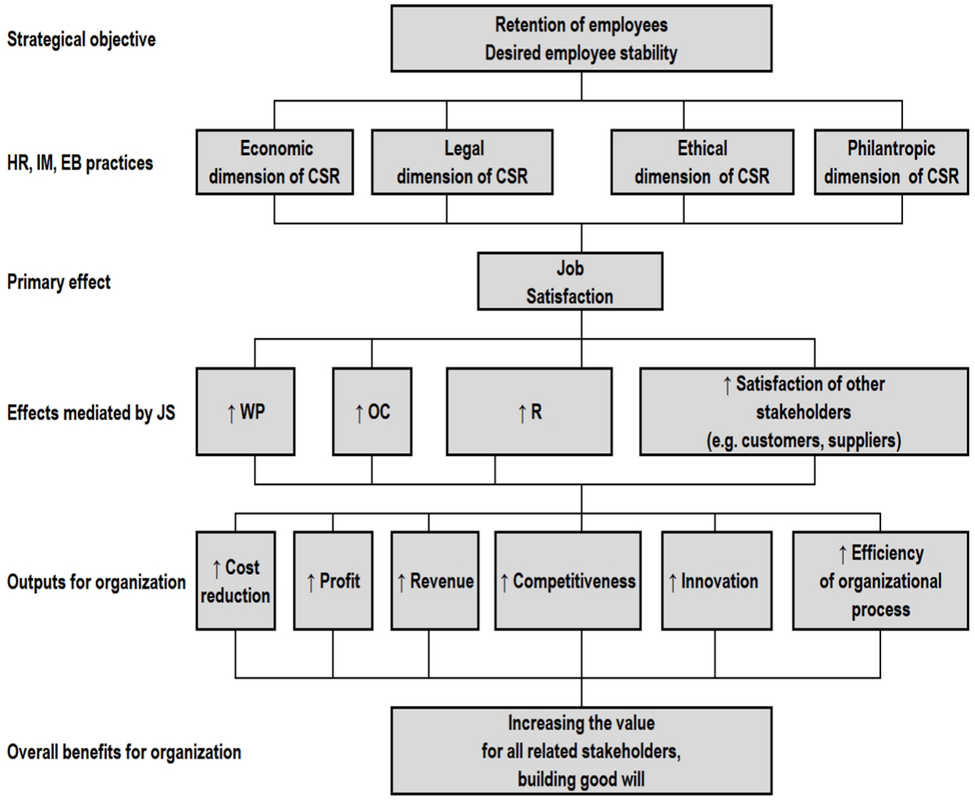


Figure 1: A proposed concept of CSR management in relation to employees (own work)

As our findings suggest, employees' performance is often the only way how to differentiate among almost identical organizational outputs, and frequently the only way how to build and attain customers' satisfaction, trust and loyalty. Therefore, appropriately implemented CSR principles into HRM, IM or EB practices both designate desirable employees' work attitudes and behaviour (e.g. increased WP, JS, OC and voluntary R) and lead to stipulating the organization's profit and revenue. Moreover, knowledgeable, satisfied and committed employees are not only "better work performers"; they are less likely to leave the organization and thus contribute to an undesirable rise in overall production cost. To ensure that all of these measures do not represent sunk costs, their compatibility with other applicable principles within the organization such as organizational structure, strategy, corporate culture, leadership and the organization's numerical flexibility is a premise.

Unfortunately, the studies under analysis mainly focused on micro-level factors, omitting macro- or multi-level factors, hindering the full understanding of the CSR concept regarding employees as the major stakeholders. Most analysed papers (63%) used either one-country-based sample or one-organization-based (32%) sample only. Although the number of respondents always met statistical criteria, we might speculate whether the obtained results are relevant and applicable for all practitioners, especially when it comes to findings regarding the causal relationship between CSR dimensions (economic, legal, ethical, and philanthropic) and employee organizational behaviour. We suggest that they are, because the above-summarized results indicate the importance for managers to view each employee as an individual due to the constant changes in his/her motivation factor preferences and changes in both, the micro- and macro-level of the environment.

CONCLUSION

This paper discussed the purpose of individual CSR dimensions as motivation drivers in stipulating employees' desirable work attitudes and behaviour such as WP, JS, OC and voluntary R using the narrative literature review (content analysis) to summarize the current "state-of-the-art" trends in academic literature. The results indicate that the employees' perceptions of CSR economic, legal, ethical and philanthropic dimensions are positively related to their work attitudes and behaviour, where JS often functions as a mediator between CSR individual dimensions and the ultimate employee behaviour desired by the organization. The findings also suggest that adding CSR activities or components into HRM, IM and EB practices could improve employees' overall work attitudes. These practices should mainly focus on attracting and retaining talented employees, maintaining physically and emotionally healthy employees and developing or improving their skills, expertise and knowledge.

Going back to the starting point of this content analysis - RQs based on Carroll (1991), it is essential to highlight that the relationship between CSR and employee organizational behaviour is mutually influential. The appropriate management of this causal relationship positively affects all relations between the organization and its stakeholders, which is in line with the holistic concept of organization.

REFERENCES

Aggerholm, H. K., Andersen, S. E. and Thomsen, C. (2011) 'Conceptualizing employer branding in sustainable organizations', *Corporate Communications: An International Journal*, vol. 16, no. 2, pp. 105-123. https://doi.org/10.1108/13563281111141642

Ahmed, P. K. and Rafiq, M. (2002) *Internal Marketing – Tools and concepts for customer-focused management*. Oxford: Butterworth-Heinemann Publications.

Ameer, R. and Othma, R. (2012) 'Sustainability practices and corporate financial performance: A study based on the top global corporations', *Journal of Business Ethics*, vol. 108, no. 1, pp. 61-79. https://doi.org/10.1007/s10551-011-1063-y

Aust, I., Brandl, J. and Keegan, A. (2015) 'State-of-the-art and future directions for HRM from a paradox perspective: introduction to the Special Issue', *German Journal of Human Resource Management*, vol. 29, no. 3-4, pp. 194-213. https://doi.org/10.1177/2397002215029003O3

Ayshath Zaheera, K. M., Khan, N. and Senthilkumar, C. B. (2015) 'E-recruitment: Criteria for its effectiveness and modern trends', *International Journal of Business Administration and Management Research*, vol. 1, no. 3, pp. 10-14.

Baker, J. D. (2016) 'The Purpose, Process, and Methods of Writing a Literature Review', *AORN Journal*, vol. 103, no. 3, pp. 265-269. https://doi.org/10.1016/j.aorn.2016.01.016

Bauman, Ch. W. and Skitka, L. J. (2012) 'Corporate social responsibility as a source of employee satisfaction', *Research in organizational Behavior*, vol. 32, pp. 63-86. https://doi.org/10.1016/j.riob.2012.11.002

Bohdanowicz, P. and Zientara, P. (2009) 'Hotel companies 'contribution to improving the quality of life of local communities, and the well-being of their employees', *Tourism Hospitality Res*., vol. 9, no. 2, pp. 147-58. https://doi.org/10.1057/thr.2008.46

Carrico, A. R. and Riemer, M. (2011) 'Motivating energy conservation in the workplace: An evaluation of the use of group-level feedback and peer education', *Journal of Environmental Psychology*, vol. 31, no.1, pp. 1-13.

Carroll, A. B. (1991) 'The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders', *Business Horizons*, vol. 34, no. 4, pp. 39-48. https://doi.org/10.1016/0007-6813(91)90005-G

Carroll, A. B. (2015) 'Corporate social responsibility: The centerpiece of competing and complementary frameworks', *Organizational Dynamics*, vol. 44, no. 2, pp. 87-96. https://doi.org/10.1016/j.orgdyn.2015.02.002

Carroll, A. B. (2016) 'Carroll's pyramid of CSR: taking another look', *International Journal of Corporate Social Responsibility,* vol. 1, no.1, 3. https://doi.org/10.1186/s40991-016-0004-6

Celma, D., Martinez-Garcia, E. and Coenders, G. (2014) 'Corporate social responsibility in Human Resources Management: An analysis of common practices and their determinants in Spain', *Corporate Social Responsibility and Environmental Management*, vol. 21, no. 2, pp. 82-99. https://doi.org/10.1002/csr.1301

Celma, D., Martinez-Garcia, E. and Raya, J. M. (2018) 'Socially responsible HR practices and their effects on employees´ wellbeing: Empirical evidence from Catalonia, Spain', *European Research on Management and Business Economics*, vol. 24, no. 2, pp. 82-89. https://doi.org/10.1016/j.iedeen.2017.12.001

Chaudhary, R. (2017) 'Corporate social responsibility and employee engagement: Can CSR help in redressing the engagement gap?', *Social Responsibility Journal*, vol. 13, no. 2, pp. 323-338. https://doi.org/10.1108/SRJ-07-2016-0115

Chen, W. and Cheng, H. (2012) 'Factors affecting the knowledge sharing attitude of hotel service personnel', *International Journal of Hospitality Management*, vol. 31, no. 2, pp. 468-476. https://doi.org/10.1016/j.ijhm.2011.07.005

CK (2019) *Overview of 2019 Global 100 Most Sustainable Corporations in the World index*, Corporate Knights, [Online], Available: https://www.corporateknights.com/reports/2019-global-100/2019-global-100-results-15481153/ [20 Oct 2019].

Cycyota, C. S., Ferrante, C. J. and Schroeder, J. M. (2016) 'Corporate social responsibility and employee volunteerism: What do the best companies do?', *Business Horizons*, vol. 59, no. 3, pp. 321-329. http://dx.doi.org/10.1016/j.bushor.2016.01.004

Dahlsrud, A. (2008) 'How corporate social responsibility is defined: an analysis of 37 definitions', *Corporate Social Responsibility and Environmental Management*, vol. 15, no. 1, pp. 1-13. https://doi.org/10.1002/csr.132

Deci, E. L. and Ryan, R. M. (1985) *Intrinsic Motivation and Self-determination in Human Behavior*. Springer-Verlag: Boston, MA.

Deci, E. L. and Ryan, R. M. (2000) 'The "what" and "why" of goal pursuits: human needs and the self-determination of behavior', *Psychological. Inquiry*, vol. 11, no. 4, pp. 227-268. https://doi.org/10.1207/S15327965PLI1104_01

Deci, E. L. and Ryan, R. M. (2008) 'Self-determination theory: macro theory of human motivation, development, and health', *Canadian Psychology*, vol. 49, no. 3, pp. 182-185. https://doi.org/10.1037/a0012801

Dhanesh, G. S. (2012) 'The view from within: internal publics and CSR', *Journal of Communication Management*, vol. 16, no. 1, pp. 39-58. https://doi.org/10.1108/13632541211197987

Diller, J. (1999) 'A social conscience in the global marketplace?', *Int. Labour Review*, vol. 138, no. 2, pp. 99-129. https://doi.org/10.1111/j.1564-913X.1999.tb00062.x

Dögl, C. and Holtbrügge, D. (2014) 'Corporate environmental responsibility, employer reputation and employee commitment: an empirical study in developed and emerging economies', *The International Journal of Human Resources Management*, vol. 25, no. 12, pp. 1739-1762. https://doi.org/10.1080/09585192.2013.859164

Duthler, G. and Dhanesh, G. S. (2018) 'The role of corporate social responsibility (CSR) and internal CSR communication in predicting employee engagement: Perspectives from the United Arab Emirates (UAE)', *Public Relations Review,* vol. 44, no. 4, pp. 453-462. https://doi.org/10.1016/j.pubrev.2018.04.001

Dutton, J. E., Dukerich, J. M. and Harquail, C. V. (1994) 'Organizational images and member identification', *Administrative Science Quarterly*, vol. 39, no. 2, pp. 239-263. https://doi.org/10.2307/2393235

European Commission (2001a) *Green paper: Promoting a European framework for corporate social responsibility*, COM 2001, 366 final, Brussels: European Commission, [Online], Available: https://ec.europa.eu/transparency/regdoc/rep/1/2001/EN/1-2001-366-EN-1-0.Pdf [20 Oct 2019].

European Commission (2001b) *Employment and social policies: Framework for investing in quality*, COM 2001, 313 final, Brussels: European Commission, [Online], Available: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2001:0313:FIN:EN:PDF [20 Oct 2019].

European Commission (2002) *Communication from the commission concerning corporate social responsibility: A business contribution to sustainable development*, COM 2002, 347 final, Brussels: European Commission, [Online], Available: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2002:0347:FIN:EN:PDF [20 Oct 2019].

European Commission (2011) *A renewed EU strategy 2011 – 2014 for corporate social responsibility*, COM 2011, 681 final, Brussels: European Commission, [Online], Available: https://www.europarl.europa.eu/meetdocs/2009_2014/documents/com/com_com(2011)0681_/com_com(2011)0681_en.pdf [20 Oct 2019].

Farooq, M., Farooq, O. and Jasimuddin, S. M. (2014) 'Employee's response to corporate social responsibility: exploring the role of employees collectivist orientation', *European Management Journal*, vol. 32, no. 6, pp. 916-927. https://doi.org/10.1016/j.emj.2014.03.002

Ferrari, R. (2015) 'Writing narrative styles literature reviews', *Medical Writing*, vol. 24, no. 4, pp. 230-235. https://doi.org/10.1179/2047480615Z.000000000329

Ferreira, P. and de Oliviera, E. (2014) 'Does corporate social responsibility impact on employee engagement?', *Journal of Workplace Learning*, vol. 26, no. 3-4, pp. 232-247. https://doi.org/10.1108/JWL-09-2013-0070

Foreman, S. K. and Money, A. H. (1995) 'Internal marketing: Concepts, measurement and application', *Journal of Marketing Management*, vol. 11, no. 8, pp. 755-768. http://dx.doi.org/10.1080/0267257X.1995.9964388

Franklin, D. (2008) 'Just good business: a special report on corporate social responsibility', *Economist*, 17 January,

Fu, H., Li, Y. and Duan, Y. (2014) 'Does employee-perceived reputation contribute to citizenship behavior? The mediating role of organizational commitment', *International Journal of Contemporary Hospitality Management*, vol. 26, no. 4, pp. 593-609.

Gagné, M. and Deci, E. L. (2005) 'Self-determination theory and work motivation', *J. Organ. Behavior*, vol. 26, no. 4, pp. 331-362. https://doi.org/10.1002/job.322

Gill, R., 2015. 'Why the PR strategy of storytelling improves employee engagement and adds value to CSR: An integrated literature review', *Public Relations Review*, vol. 41, no. 5, pp. 662-674. https://doi.org/10.1016/j.pubrev.2014.02.012

Graves, L. M., Sarkis, J. and Gold, N. (2019) 'Employee pro-environmental behaviour in Russia: The roles of top management commitment, managerial leadership, and employee motives', *Resource, Conservation and Recycling*, vol. 140, pp. 54-64. https://doi.org/10.1016/j.resconrec.2018.09.007

Gregory-Smith, D., Wells, V. K., Manika, D. and Graham, S. (2015) 'An environmental social marketing intervention among employees: Assessing attitude and behaviour change', *Journal of Marketing Management*, vol. 31, no. 3/4, pp. 336-377. https://doi.org/10.1080/0267257X.2014.971045

Gully, S. M., Phillips, J. M., Castellano, W. G., Han, K. and Kim, A. (2013) 'A mediated moderation model of recruiting socially and environmentally responsible job applicants', *Personnel Psychology*, vol. 66, no. 4, pp. 935-973. https://doi.org/10.1111/peps.12033

Gupta, N. and Sharma, V. (2016) 'The relationship between corporate social responsibility and employee engagement and its linkage to organizational performance: A conceptual model', *The IUP Journal of Organizational Behavior*, vol. 15, no. 3, pp. 59-75.

Hagenbuch, D. J., Little, S. W. and Lucas, D. J., 2015. 'Beyond association: How employees want to participate in their firms 'corporate social performance', *Business and Society Review*, vol. 120, no. 1, pp. 83-113. https://doi.org/10.1111/basr.12049

Huang, Y. T. and Rundle-Thiele, S. (2014) 'The moderating effect of cultural congruence on the internal marketing practice and employee satisfaction relationship: an empirical examination of Australian and Taiwanese born tourism employees', *Tourism Management*, vol. 42, pp. 196-206. https://doi.org/10.1016/j.tourman.2013.12.005

ISO (2017) *ISO 26000:2010 Guidance on Social Responsibility*, International Organization for Standardization, [Online], Available: https://www.iso.org/standard/42546.html [20 Oct 2019].

Jakubczak, A. and Gotowska, M. (2015) 'The quality of work life and socially responsible actions directed at employees on the example of a service company', *Acta Scientiarum Polonorum. Oeconomia*, vol. 14, no. 1, pp. 37-46.

John, A., Qadeer, F., Shahzadi, G. and Jia, F. (2019) 'Getting paid to be good: How and when employees respond to corporate social responsibility?', *Journal of Cleaner production*, vol. 215, pp. 784-795. https://doi.org/10.1016/j.jclepro.2019.01.074

Jones, D. A., Willness, C. R. and Madey, S. (2014) 'Why are job seekers attracted by corporate social performance? Experimental and field tests of three signal-based mechanisms', *Academy of Management Journal*, vol. 57, no. 2, pp. 383-404. https://doi.org/10.5465/amj.2011.0848

Joung, H. W., Choi, E. K., Lee, D. S. and Kim, H. S. (2015a) 'Exploring Internal Marketing Mix and Its Applications in the Foodservice Industry', *Culinary Science and Hospitality Research*, vol. 21, no. 5, pp. 192-203. https://doi.org/10.20878/cshr.2015.21.5.018

Joung, H. W., Goh, B. K., Huffman, L., Yuan, J. J. and Surles, J. (2015b) 'Investigating relationships between internal marketing practices and employee organizational commitment in the foodservice industry', *International Journal of Contemporary Hospitality Management*, vol. 27, no. 7, pp. 1618-1640. https://doi.org/10.1108/IJCHM-05-2014-0269

Kim, H. R., Lee, M., Lee, H, T. and Kim, N. M. (2010) 'Corporate social responsibility employee-company identification', *Journal of Business Ethics*, vol. 95, no. 4, pp. 557 - 569. https://doi.org/10.1007/s10551-010-0440-2

Kim, J. J., Eom, T. K., Kim, S.W. and Youn, M. K. (2015) 'Effects of ethical management on job satisfaction and turnover in the South Korean service industry', *International Journal of Industrial Distribution and Business*, vol. 6, no. 1, pp. 17-26. https://doi.org/10.13106/ijidb.2015.vol6.no1.17

Kim, J., Song, H. J. and Lee, Ch. K. (2016) 'Effects of corporate social responsibility and internal marketing on organizational commitment and turnover intentions', *International Journal of hospitality Management*, vol., 55, pp. 25-32. https://doi.org/10.1016/j.ijhm.2016.02.007

Kim, H. L., Rhou, Y., Uysal, M. and Kwon, N. (2017) 'An examination of the links between corporate social responsibility (CSR) and its internal consequences', *International Journal of Hospitality Management*, vol. 61, pp. 26-34. https://doi.org/10.1016/j.ijhm.2016.10.011

King, C. and Grace, D. (2010) 'Building and measuring employee-based brand equity, *European Journal of Marketing*', vol. 44, no. 7, pp. 938-971. https://doi.org/10.1108/03090561011047472

Kramar, R., 2014. 'Beyond strategic Human Resources management: is sustainable Human Resources management the next approach?', *International Journal of Human Resource Management*, vol. 25, no. 8, pp. 1069-1089. https://doi.org/10.1080/09585192.2013.816863

Lim, J. S. and Greenwood, C. A. (2017) 'Communicating corporate social responsibility (CSR): Stakeholder responsiveness and engagement strategy to achieve CSR goals', *Public Relations Review*, vol. 43, no. 4, pp. 768-776. https://doi.org/10.1016/j.pubrev.2017.06.007

Macke, J. and Genari, D., 2019. 'Systematic literature review on sustainable Human Resources management', *Journal of Cleaner Production*, vol. 208, pp. 806-815. https://doi.org/10.1016/j.jclepro.2018.10.091

Maignan, I. and Ferrell, O. C. (2001) 'Corporate citizenship as a marketing instrument Concepts, evidence and research directions', *European Journal of Marketing*, vol. 35, no. 3-4, pp. 457-484. https://doi.org/10.1108/03090560110382110

Maslow, A. H. (1943) 'A theory of human motivation', *Psychological Review*, vol. 50, no. 4, pp. 370-396. http://dx.doi.org/10.1037/h0054346

Marler, J. H. and Boudreau, J. W. 2017. 'An evidence-based review of HR analytics', *The International Journal of Human Resources Management*, vol. 28, no.1, pp. 3-26. https://doi.org/10.1080/09585192.2016.1244699

Mayer, J. P., Becker, T. E. and Vandenberghe, C. (2004) 'Employee commitment and motivation: a conceptual analysis and integrative model', *Journal of Applied Psychology*, vol. 89, no. 6, pp. 991-1007. https://doi.org/10.1037/0021-9010.89.6.991

Morsing, M. and Schultz, M. (2006) 'Corporate social responsibility communication: Stakeholder information, response and involvement strategies', *Business Ethics: A European Review*, vol. 15, pp. 323-338. https://doi.org/10.1111/j.1467-8608.2006.00460.x

OECD (2018) *Responsible Business Conduct, Guidelines for Multinational Enterprises*, Organization for Economic Co-operation and Development, [Online], Available: http://mneguidelines.oecd.org/ [20 Oct 2019].

Ong, M., Mayer, D. M., Tost, L. P. and Wellman, N. (2018) 'When corporate social responsibility motivates employee citizenship behavior: The sensitizing role of task significance', *Organizational Behavior and Human Decision Processes*, vol. 144, pp. 44-59. https://doi.org/10.1016/j.obhdp.2017.09.006

Peterson, D. K. (2004) 'The relationship between perceptions of corporate citizenship and organizational commitment', *Bus. Soc*. vol. 43, no. 3, pp. 296-319. https://doi.org/10.1177/0007650304268065

Puncheva-Michelotti, P., Hudson, S. and Jin, G. (2018) 'Employer branding and CSR communication in online recruitment advertising', *Business Horizons*, vol. 61, no. 4, pp. 643-651. https://doi.org/10.1016/j.bushor.2018.04.003

Rafiq, M. and Ahmed, P. K. (2000) 'Advances in the internal marketing concept: definition, synthesis and extension', *Journal of Services Marketing*, vol. 14, no. 6, pp. 449-462. https://doi.org/10.1108/08876040010347589

Ruizalba, J. L., Bermúdez-González, G., Rodríguez-Molina, M. A. and Blanca, M. (2014) 'Internal market orientation: An empirical research in hotel sector', *International Journal of Hospitality Management*, vol. 38, pp. 11-19. https://doi.org/10.1016/j.ijhm.2013.12.002

SAI (2019) *SA8000 Standard*, Social Accountability International, [Online], Available: http://www.sa-intl.org/index.cfm?fuseaction=Page.ViewPage&PageID=1689 [20 Oct 2019].

Sanchez-Hernandez, I. and Grayson, D. (2012) 'Internal marketing for engaging employees on the corporate responsibility journey', *Intangible Capital*, vol. 8, no. 2, pp. 275-307. http://dx.doi.org/10.3926/ic.305

Sirgy, M. J., Efraty, D., Siegel, P. and Lee, D. J. (2001) A new measure of quality of work life (QWL), based on need satisfaction and spillover theories', *Social Indicators Research*, vol. 55, no. 3, pp. 241-302. https://doi.org/10.1023/A:1010986923468

Soane, E., Truss, C., Alfes, K., Shantz, A., Rees, C. and Gatenby, M. (2012) 'Development and application of a new measure of employee engagement: The ISA Engagement Scale', *Human Resources Development International*, vol. 15, no. 5, 529-547. https://doi.org/10.1080/13678868.2012.726542

Stone, D. L. and Deadrick, D. L. (2015) 'Challenges and opportunities affecting the future of Human Resources Management', *Human Resources Management Review*, vol. 25, no. 2, pp. 139-145. https://doi.org/10.1016/j.hrmr.2015.01.003

Taneja, S. S., Taneja, P. K. and Gupta, R. K. (2011) 'Researches in corporate social responsibility: a review of shifting focus, paradigms, and methodologies', *Journal of Business Ethics*, vol. 101, pp. 343-364. https://doi.org/10.1007/s10551-010-0732-6

Tkalac Verčič, A.and Sinčić Ćorić, D. (2018) 'The relationship between reputation, employer branding and corporate social responsibility', *Public Relations Review*, vol. 44, no. 4, pp. 444-452. https://doi.org/10.1016/j.pubrev.2018.06.005

UN Global Compact (2019) *United Nations Global Compact*, [Online], Available: https://www.unglobalcompact.org/ [20 Oct 2019].

Voegtlin, Ch. and Greenwood, M. (2016) 'Corporate social responsibility and Human Resources Management: A systematic review and conceptual analysis', *Human Resources Management Review*, vol. 26, no. 3,pp. 181-197. https://doi.org/10.1016/j.hrmr.2015.12.003

Wu, W., Tsai, Ch. and Fu, Ch. (2013) 'The relationship among internal marketing, job satisfaction, relationship marketing, customer orientation, and organizational performance: An empirical study of TFT-LCD companies in Taiwan', *Human Factors and Ergonomics in Manufacturing and Service Industries*, vol. 23, no. 5, pp. 436-449. https://doi.org/10.1002/hfm.20329

Yao, T., Qiu, Q. and Wei, Y. (2019) 'Retaining hotel employees as internal customers: Effect of organizational commitment on attitudinal and behavioral loyalty of employees, *International Journal of Hospitality Management*, vol. 76, pp. 1-8. https://doi.org/10.1016/j.ijhm.2018.03.018

Youn, H., Lee, K. and Lee, S. (2018) 'Effects of corporate social responsibility on employees in the casino industry', *Tourism Management*, vol. 68, pp. 328-335. https://doi.org/10.1016/j.tourman.2018.03.018

Zhang, H., Fu, X., Cai, L. A. and Lu, L. (2014) 'Destination image and tourist loyalty: a meta-analysis', *Tourism Management*, vol. 40, pp. 213-223. https://doi.org/10.1016/j.tourman.2013.06.006

Zhang, Q., Oo., B. L. and Lim, B. T. H. (2019) 'Drivers, motivations, and barriers to the implementation of corporate social responsibility practices by construction enterprises: A review', *Journal of Cleaner Production*, vol. 210, pp. 563-584. https://doi.org/10.1016/j.jclepro.2018.11.050

Full research paper

EFFECTS OF TEACHING A LEARNING PSYCHOLOGY COURSE IN DIFFERENT WAYS ON THE STUDENT'S SUCCESS AND ATTITUDES

Şeyma Şahin
Burcu Ökmen✉
Abdurrahman Kılıç

Düzce Üniversitesi, Turkey

✉ burcuokmen91@hotmail.com

ABSTRACT

The aim of this study is to determine the effect of teaching a learning psychology course in different ways on students' academic success and attitudes towards the course. The experimental research method was used in this research. The participants were students in the second year of a psychological counseling and guidance program in a state university in Turkey. The data were collected by Learning Psychology Course Achievement Test and student letters. ANOVA, Kruskal Wallis and Wilcoxon Signed Rows test were used in the analysis. Student letters were analyzed through content analysis. In the first group, the lecturer taught the class interactively each week with the presentations prepared by the researchers. In the second group, no lectures were made in this group. At the beginning of the lesson each week, students were given the outputs of the presentations and the lesson was carried out with two activities each week. In the third group, the flipped learning model was applied in this group. As a result of the study, it was concluded that the standard deviation was smaller in the group in which the flipped learning model was applied compared to the other two groups.

KEYWORDS

Flipped learning model, learning psychology course, student attitude, student-centered education, student success

HOW TO CITE

Şahin Ş., Ökmen B., Kılıç A. (2020) 'Effects of Teaching the Learning Psychology Course in Different Ways on the Student's Success and Attitudes', *Journal on Efficiency and Responsibility in Education and Science*, vol. 13, no. 3, pp. 113-129. http://dx.doi.org/10.7160/eriesj.2020.130302

Article history
Received
April 22, 2020
Received in revised form
March 15, 2020
Accepted
July 31, 2020
Available on-line
September 30, 2020

Highlights

- *The students' learning performances were close to each other, and the students in the whole group learned well.*
- *The standard deviation was smaller in the group in which the flipped learning model was applied. This shows that the flipped learning model is effective on students' success.*
- *The students in the flipped learning group liked the lesson very much, found the lesson efficient, had fun, and were surprised at how quickly time passed.*
- *The students in the flipped learning group thought that group studies contributed to their exchanges of ideas with their friends, getting to know each other, and learning from each other.*

INTRODUCTION

Global changes in science and technology have had a significant impact on education as well as many other fields (Benson, 2012). The purpose of education today is to train students who can solve problems, adapt their knowledge to real life, work collaboratively, and engage in lifelong learning (Hains and Smith, 2012). For this reason, educational environments in which the student merely watches on the sidelines and the teacher works as the only actor in the classroom cannot attract the attention of the students. It is not possible to have effective and permanent learning in such environments (Rodriguez-Valls and Ponce, 2013).

The strength of student-centered education comes from the fact that it allows students to learn from their own experience, to structure information, and to reflect on it (Daley, 2003). Scientific research supports student-centered education. Studies show that student-centered education increases

students' motivation for learning, increases the level of knowledge recall, provides in-depth knowledge, and has positive effects on creativity, critical thinking, success, student participation, student satisfaction, student self-esteem, and learning motivation (Kılıc and Sahin, 2016; Maden, Durukan and Akbaş, 2011; Salinas, Kane-Johnson and Vasil-Miller, 2008; Scott, Buchanan and Haigh, 1997; Smart and Csapo, 2007).

Effective teaching practices can be implemented by using different methods and techniques in line with student-centered education principles. Teachers should learn and try different methods and techniques in order to better respond to students' interests, wishes, and needs and to organize the classroom better (Ha, 2013). When the results of the research in the literature are examined, it is seen that student-centered strategies, methods, and techniques such as project-based learning, inquiry-based learning, problem-based learning, collaborative learning, and flipped learning are used, which are effective in increasing academic success (Baepler, Walker and Driessen, 2014; Donovan and Lee, 2015; Green, 2015; Harvey, 2014; Lazonder and Harmsen, 2016; McCallum et al., 2015; Vernon and Blake 1993).

Within the scope of this research, it was aimed to conduct a course effectively while using different teaching methods to make the students active. For this reason, three different lesson designs of different styles and levels were prepared, each aiming to bring the students to the center and make them active. By comparing these lesson designs, it was aimed to reveal the advantages and disadvantages of each and thus guide teachers who want to use different methods and techniques in their classrooms.

One of the student-centered strategies used in this research is the flipped learning model. The flipped learning model is a model that includes traditional learning in the classroom and online learning, which is also described as a blended learning approach and has become quite popular recently (Bergmann and Sams, 2012; Tucker, 2012). Flipped learning is one of the models used by integrating technology into student-centered education. With the introduction of technology into educational environments, it allowed the design of teaching materials suitable for different student characteristics, and besides enriching the educational environments, it enabled efficient learning environments to be created by facilitating accessibility ofeducational environments (Nemtchinova, 2007). According to Sams and Bergmann (2013), the main component of the flipped learning model is increasing the quality of face-to-face education by using the most efficient time spent at school with students. It is stated that the work done at home increases the students' active participation and success (Frydenberg, 2012; Okmen, 2020; Stone, 2012; Talbert, 2012). While students acquire lower-level information outside the classroom through technology, they use their higher-level thinking skills with teachers and classmates in the classroom (Bergmann and Sams, 2012).

In addition to these positive features, some negative features of the flipped learning model are also mentioned in the literature. Talbert (2012) states that in this model, students should work individually at home and watch the content of the lessons, but this creates difficulties for students who do not have individual learning habits. There are studies that say that the obligation to work at home is a disadvantage of this model (Alsancak Sirakaya, 2015; Turan and Goktas, 2015). Considering these disadvantages of flipped learning in the literature, in this study, students in one group were taught using a different model suitable for student-centered understanding. In this model, the home learning section, which is seen as a disadvantage of flipped learning, was removed and every stage of teaching and learning was carried out only at school. In this way, it was tested whether a new model could be introduced by producing a solution to the disadvantageous parts of the flipped learning model.

In the third model applied within the scope of the research, the course was taught in the style of presentations, but interaction was provided with the students using the question-and-answer technique. The question-and-answer technique, which is seen as a way to make students effective, is a technique used to learn what students understand, to increase their interest in the lesson, and to develop higher-level thinking skills (Kubat, 2018). While teachers determine the level of learning through questions and whether learning takes place in an organized manner, they offer the student the opportunity to learn a new topic (Buyukalan Filiz, Celik, and Toraman 2018). Although the question-and-answer method does not fully comply with the student-centered understanding, the effect of asking students for examples, interactive lesson processing, and requesting a portfolio with the requested homework at the end of the course was investigated and the effects of this method were compared with the other methods.

In this study, it was aimed to conduct lessons effectively by using different teaching methods to make the students active and to make comparisons between these three models used in the course process. In this context, the aim of this study is to determine the effect of teaching a learning psychology course in different ways on students' academic success and attitudes towards the course. This basic purpose has been applied to answer the following questions in the research framework:

- What is the effect of teaching a learning psychology course in different ways on students' academic success?
- What are the opinions of the students about the lessons?

MATERIALS AND METHODS

This section includes information on the research model, working group, application process, data collection, data analysis, and validity and reliability.

Research Model

Experimental research method was used in this research. Experimental researches are studies to test the effect of differences created by the researcher on the dependent variable (Buyukozturk et al., 2013). "Pretest-posttest group design" was used to determine the effect of the course on students' academic achievement. Each of the groups in the design was assigned as an experimental group. The symbolic view of the design was given in Table 1:

	Pretest	Treatment	Posttest
E_1	P_1	X_1	P_4
E_2	P_2	X_2	P_5
E_3	P_3	X_3	P_6

E1: Experiment Group-1, E2: Experiment Group-2, E3: Experiment Group-3

P1,2,3: Pretest, P4,5,6: Posttest

X1: Experiment Process-1, X2: Experiment Process-2, X3: Experiment Process-3

Table 1: Pretest-Posttest Research Design

Working Group

The participants were Psychological Counseling and Guidance program students studying in 2nd class in a state university in Turkey. The working group was determined by the "convenient sampling" method. Convenient sampling is based on the items that are available, fast and easy to reach (Baltacı, 2018). In this study, the students of the three classes currently taking the course constituted the working group. The numbers of females and males in the working groups were given in Table 2:

	Female	Male	Total
1st Group	25	12	37
2nd Group	19	9	28
3rd Group	28	12	40
Total	72	33	105

Table 2: Number of Working Group Students

As can be seen in Table 2, there are 105 students in the study group. There are 37 students in the first group, 28 students in the second group and 40 students in the third group. 72 students are females and 33 are males.

In order to determine the equivalence of the groups, it was examined whether there was a significant difference between the students' GPA (Grade Point Average) scores. GPA of the students were obtained from the university system. ANOVA test results for this purpose were given in Table 3:

	N	Mean	Standard Deviation	*df*	*F*	*p*-value
Group 1	31	2.87	0.25			
Group 2	21	2.96	0.31	2	0.96	0.39
Group 3	34	2.88	0.18			

Table 3: ANOVA Test Results Regarding GPA Scores of Groups

As can seen in Table 3, according to the ANOVA test results, there was no significant difference between the groups' GPA scores ($F = 0.961$, $p > 0.05$). In this case, it can be said that all groups were equivalent in terms of GPA scores.

In order to determine the equivalence of the groups in terms of information related to the course, "learning psychology course pre-test" was applied before the research. ANOVA test results related to the differences between the pretest scores of the groups were given in Table 4:

	N	Mean	Standard deviation	*df*	*F*	*p*-value
Group 1	31	46.65	6.68			
Group 2	21	47.43	9.06	2	0.35	0.71
Group 3	34	45.41	10.86			

Table 4: ANOVA Test Results Regarding the Pretest Scores of the Groups

As seen in Table 4, ANOVA test did not show any significant difference between the groups according to the pretest results ($F = 0.35$, $p > 0.05$). In this case, it can be said that the information of each group was equivalent to each other before the applications.

Application Process

The application process of the research was carried out by the lecturer and two doctoral students who are responsible for conducting the course at the university.

Before this application, a term plan was prepared for each group by the researchers. The learning psychology course, which lasted 14 weeks in total, was held on Wednesday each week in three groups. In the first three weeks, basic information was given in all groups and pretesting was applied. Experimental application started on 4th week and lasted for a total of 11 weeks. The evaluation of the course was done with the final exam and portfolio. At the end of 14 weeks, the final test that replaced the final exam was applied and student portfolios were evaluated.

First Group

In this group, the lecturer taught lesson interactively each week through the presentation prepared by the researchers. During the lesson, the examples in the presentation were given and students were asked to create various examples. In addition, the lecturer enriched the presentation of the lesson with various stories, jokes and memories. The output of the presentation was distributed to the students at the beginning of each lesson and the students took notes on these outputs while listening to the lesson. At the end of the lesson, students were given homework and asked to put this homework in their portfolios. As homework, tasks such as preparing questions, writing examples, finding similarities and differences, preparing concept maps, preparing puzzles, writing acrostic or poetry, writing slogans, writing the reflection of theories on education were given.

Second Group

No lecture was made in this group. At the beginning of the lesson each week, students were given the outputs of the presentations and the reflections of theories on education, and the students were asked to read and discuss these in the first weeks individually and in the next weeks in groups. For this, students were given 20-30 minutes. After that, the lesson was carried out with two activities each week, which made it necessary to use the information on the subjects. In this process; snowball, station, bearing, thinking with six hats, fishbone, butter-bread, aquarium, drama techniques; writing poetry, completing stories, preparing puzzles, writing letters, matching cards, drawing questions from the jar, finding similarity-difference, preparing a concept map, structured grid activities were used. In this group, no assignment was given for the pre-class and post-class learning period. The students were asked to put their studies in their portfolios. Students were given compensatory duties for weeks when they couldn't attend classes.

Third Group

The flipped learning model was applied in this group. Lecturing videos were taken through the presentations prepared for each lesson. Before the lesson, the lecturing videos and a document was sent to the students. Before coming to class, students were asked to watch the video, write the examples, read the document about the reflection of the theory on education and do the task (preparing a question, summarizing and answering the given question). Before the students came to class, they sent their tasks to the researchers via WhatsApp and received the necessary feedback. In the course, three different activities were organized for the students each week. In this process; snowball, station, bearing, thinking with six hats, fishbone, butter-bread, aquarium, drama techniques; writing poetry, completing stories, preparing puzzles, writing letters, matching cards, drawing questions from the jar, finding similarity-difference, preparing a concept map, structured grid activities were used. In this group, no assignment was given for the pre-class and post-class learning period. The students were asked to put their studies in their portfolios. Students were given compensatory duties for weeks when they couldn't attend classes.

Data Collection

The data were collected by "Learning Psychology Course Achievement Test" and student letters.

Learning Psychology Course Achievement Test

In this research, "Learning Psychology Course Achievement Test" was developed to measure the academic success levels of the students at the end of the application. First of all, a table of specifications was prepared in order to ensure the content validity. Within the scope of this specifications table, a question pool consisting of 109 questions was created by three researchers. A pilot application was carried out to ensure the validity and reliability of the achievement test. For this purpose, two separate pilot test forms with 109 questions in the question pool were prepared. Test-1 form consisting of 55 questions was applied to 132 students and Test-2 form consisting of 54 questions was applied to 133 students. Students who took the test were university students who took the learning psychology course before. As a result of the analyzes, the average item difficulty of Test-1 was 0.40, and the average item difficulty of Test-2 was 0.40.

A total of 50 questions were selected by the researchers, taking into account the table of specifications and pilot application analysis results for use in the final test. As a result of the pilot application, items with less than 0.2 item discrimination indexes were not used in the final test. 6 items from Pilot Test-1 with item discrimination indexes between 0.2 and 0.29 and 2 items from Pilot Test-2 were used in the final test by arranging the answer options.

The final test was applied as a pre-test at the beginning of the semester and as a post-test at the end of the semester. All of the 105 students (Group-1 = 31, Group-2 = 21, Group-3 = 34) participated in all of the tests in the study group.

Student Letter

In order to determine their attitude towards the lesson, the students were asked to write a letter about their feelings and thoughts about the process at the end of the semester. Letters were received from 93 of 105 students (Group-1 = 34, Group-2 = 22, Group-3 = 37) in the study group

Data Analysis

The analysis of quantitative and qualitative data collected in the research was explained under separate headings.

Quantitative Data Analysis

Data were analyzed by using a statistic program to determine the effect of the flipped learning model on academic achievement. First of all, normality tests were carried out. If the sample size is greater than 35, the Kolmogorov-Smirnov (K-S) test can be used, and if it is small, the Shapiro-Wilk test can be used (Demir, Saatcioğlu and İmrol, 2016). Since the sample size in all the groups in this study is less than 35, Shapiro-Wilk test results are taken as the basis. According to the normality test results, it was observed that the students' GPA (Grade Point Average) and pre-test scores were normally distributed in each group, and the post-test scores did not show the normal distribution in any group.

ANOVA, one of the parametric tests, and Kruskal Wallis test, which is one of the non-parametric tests, and Wilcoxon Signed Rows test were used in the analysis.

Qualitative Data Analysis

Student letters were analyzed through content analysis. Content analysis is defined as a detailed and careful examination of a particular material to define patterns, categories or meanings (Leedy and Ormrod, 2005; Neuendorf and Kumar, 2002). The data analysis process was carried out in three stages (Kilic et al., 2019): organizing data, summarizing data and associating/interpreting. The data were combined and grouped and made ready for analysis at the stage of organizing data. The forms were coded to express each participant. These codes were also used in direct quotes. During the stage of summarizing data; coding and classification processes were carried out. The data were coded by two researchers, then the codes were compared and the missing ones were completed. Later, during the stage of the classification stage, these codes were collected under categories and subcategories. The categories that emerged were interpreted by associating them with each other at the stage of association/interpretation.

Validity-Reliability

Kuder Richardson-20 (KR-20) reliability was used to examine the internal consistency of the achievement test. As a result of the calculation, the reliability coefficient of Test-1 (KR–20) was 0.806, and the reliability coefficient of Test-2 (KR-20) was 0.861. Tests with a reliability coefficient of 0.70 and above are generally considered to have sufficient reliability (Fraenkel and Wallen, 2000). In this case, both tests can be said to be reliable.

The data collection and analysis process is explained in detail for the validity and reliability of qualitative data. In the content analysis, the creation of categories was done meticulously. The content analyzed data was coded separately by two researchers. The consistency was calculated using the reliability formula proposed by Miles and Huberman (1994) and the agreement between the codings was found to be 89% compliance. Missing codes were examined by examining non- agreement codes. Objectivity was tried to be obtained through direct quotations from student letters. All raw data of the study was filed and stored for review.

RESULTS

In this research work, after the analysis of qualitative and quantitative data, the findings of each data type were presented separately. Results were gathered under the titles of "academic success" and "opinions about the conduction of the course."

Academic Achievements

Academic success was examined under the titles which are "comparison of the pretest-posttest scores of the groups" and "comparison of the posttest scores of the groups".

Comparison of the Pretest-Posttest Scores of the Groups

Descriptive statistics related to the pretest and posttest scores of the groups were given in Table 5:

	N		Mean	Standard deviation
Group 1	31	Pretest	46.65	6.68
		Posttest	76.39	13.36
Group 2	21	Pretest	47.43	9.06
		Posttest	77.33	12.03
Group 3	34	Pretest	45.41	10.86
		Posttest	79.18	7.63

Table 5: Descriptive Statistics on Pretest and Posttest Scores

Looking at the statistics in Table 5, it is seen that the posttest scores of all groups are quite high. Looking at the last test averages, it can be seen as the averages from the highest to the lowest are Group 3 ($X = 79.18$), Group 2 ($X = 77.33$), and Group 1 ($X = 76.39$). The highest value belongs to the 3rd group who applied flipped learning.

It is seen that Group 3 has the highest standard deviation ($s = 10.86$) in the pretest, but the lowest standard deviation ($s = 7.63$) in the posttest. It is also seen that Group 1 has the lowest standard deviation ($s = 6.68$) in the pretest, but it has the highest standard deviation ($s = 13.36$) in the posttest. A smaller standard deviation means that students' test scores are close to each other and so their learning is close to each other, that is, students learn well together. The fact that a higher standard deviation indicates that the distribution of the group moves away from the normal distribution, and that means that, there are students who learn well as well as students who do not learn well. This means that the teaching service offered to Group 3 is of higher quality.

The results of Wilcoxon Signed Ranks test performed to determine whether there is a significant difference between the pretest and posttest scores of the groups were given in Table 6:

	N	Mean rank	Sum of ranks	*z*-value	*p*-value
Group 1	0	0.00	0.00	-4.86	0.00
	31	16.00	496.00		
	0				
Group 2	0	0.00	0.00	-4.02	0.00
	21	11.00	231.00		
	0				
Group 3	0	0.00	0.00	-5.09	0.00
	34	17.50	595.00		
	0				

Table 6: Wilcoxon Signed Ranks Test Results Regarding Pretest-Posttest Scores

When Table 6 is examined, it is seen that there is a significant difference between the pre-test and post-test scores of the students who take "learning psychology course success test". They are ($z = -4.86, p < 0.001$) in Group 1, ($z = -4.02, p < 0.001$) in Group 2 and ($z = -5.09, p < 0.001$) in Group 3. It is seen that these differences are in favor of the post-test in each group. In this case, it can be said that the operations performed in each group positively affected learning.

Comparison of the Posttest Scores of the Groups

Kruskal Wallis test was performed to determine whether there was a significant difference between the post-test scores of the groups at the end of the course. The Kruskal Wallis test results regarding the posttest scores of the groups were given in Table 7:

	N	Mean rank	Standart deviation	X^2	p-value
Group 1	31	43.08			
Group 2	21	43.64	2	0.01	0.99
Group 3	34	43.79			

Table 7: Kruskal Wallis Test Results Regarding Posttest Scores

As seen in Table 7, no significant difference was detected between the posttest scores of the groups (X^2 = 0.01, $p > 0.05$). This shows that the applications done on three different groups do not differ academically.

Student Opinions

The opinions of the students about the conduction of the course were examined separately for each group.

Opinions of the Students in the First Group

Opinions of the students in the first group, where courses were taught interactively with the students through slides are discussed under three headings which are "Views on the design of the course", "opinions on examples, stories and memories" and "opinions on homework".

Opinions on the Design of the Course

The opinions of the students in the first group regarding the design of the course were given in Table 8:

Categories		Codes
Positive Views	Learning	Giving lecture is useful and efficient. It was impossible to understand the lecture without listening. This style of learning is better than the ones in other groups. The distributing presentations' printouts was effective in learning. Enabled the subject to perceive as a whole.
	Course Participation	There was an active lecture giving. Student was also effective in giving lecture.
	Permanence	The information was catchy.
	Attractiveness	The course was interesting and beautiful. I came to lecture willingly. I hung on the course's every word. I left the class happily. I excitedly waited for the next course. I liked the course and enjoyed it.
Negative Views	Learning	I would understand better with the station technique.
	Course Participation	I tried to participate in the course, but I could not. Slides were read in the course, and the students could not participate. I did not attend the course, and I do not like to attend anyway. It should have been interactive.
	Permanence	Subject teaching is not permanent. I noticed that I forgot the information right after the course.
	Attractiveness	It wasn't fun like the other group. I would love to try it. Using the same method every week caused fading. Plain lecturing was not nice. The course was boring. I was tired at the end of the course. Sometimes I was sleepy in the course. The content caused students to lose attention. The course time was long.
	Diversity	It would have been nice to done some activities during the course. Different materials should have been used. There should have been different methods and techniques. It was upsetting that the station techniques was not used.

Table 8: Opinions on the Design of the Course

As can be seen in Table 8, the students' views on the design of the course were categorized under two categories as "positive opinions" and "negative opinions".

It is seen that students have positive and negative opinions about the way the course is taught. Although it is stated that this method has a positive effect on attendance, it is seen that the method is negative in terms of student participation. The students think that the course is not interactive and they cannot participate in the course with this method. There are two different opinions that the course provides permanence and not. When positive opinions are examined in terms of attractiveness, it is seen that some of the students love the course, attend it intentionally and leave it happily.

It is striking that some of them dislike the course and think it is long, tiring and boring. In the Diversity subcategory, it is observed that students want to do activities, learn with fun, use different materials with different methods and techniques. Although they want to learn with diversity and fun and do not find the course very interesting, it is discovered that students generally think that they understand the course better in this way. It is noticed that students think that good learning is provided through lecture giving, it is not possible to understand the course without listening, and they are able to perceive the subject as a whole very well in this way.

Some direct quotes from students' opinions under these categories are given below:

S9: "*I think it is more beneficial to carry out the course in the form of a station technique. Because plain lecturing and giving homework is not interesting.*"

S19: "*I think just giving examples in the course, which rarely happened, was not enough. I was trying to participate more in the course and digest the content but unfortunately this was not always happening.*"

Opinions on Examples, Stories and Memories

The opinions of students in the first group regarding examples, stories and memories were given in Table 9:

Categories		Codes
Positive Opinions	Given by the teacher	Sudden rises and reactions attracted attention. It was stunning, diverse, interesting and beautiful. I would like to listen to it more. It provided permanence. It was effective in learning. It provided reinforcement. It was nice to listen to the past experiences.
	Requested from student	It was effective, useful and efficient. It made me feel my ideas were valuable. He made the student active. He established a connection between the student and the course. Made the student stay awake during the course.
Negative Opinions		Examples are similar, different examples should be given. We were able to give examples rarely. Sometimes not giving examples made it difficult for me to understand.

Table 9: Opinions on Examples, Stories and Memories

As can be seen in Table 9, students' opinions about examples, stories and memories are categorized under two categories as "positive opinions" and "negative opinions".

It is seen that students have positive and negative opinions about the examples, stories and memories in the course, but positive opinions are quite high. The students think that the examples given by the teacher, the stories and memories he tells are interesting and beautiful, are effective in learning, and are useful in terms of permanence and strengthening. It is also seen that students find it effective and beneficial to be asked for samples and thus they feel active in the course. However, there are also some students who think that there are not enough examples given by the teacher and that they cannot give enough examples.

Some direct quotes from students' opinions under these categories are given below:

S27: "*When you give examples in the course, you give very similar examples or I confuse them because the theories are similar. My request to you is to give wide variety of examples, not only through us or similar things, while giving examples in the lesson.*"

S28: "*The examples given in the course and your memories that you shared with us were very nice. Occasionally, when you take examples from us and use it in the course helped us learn many things.*"

Opinions about Homework

The opinions of the students in the first group regarding the homework were given in Table 10.

As can be seen in Table 10, students' views on homework are categorized under two categories as "positive opinions" and "negative opinions".

It is observed that students have both positive and negative views towards homework. Some of the students think that homework offers the opportunity to repeat topics, strengthen the course and contribute positively to their learning. It is seen that some students think that homework such as acrostic, poetry, writing slogans are unnecessary and useless, they should be done during the course instead of being given as homework, and homework should be checked daily.

There are students who find their homework interesting as well as students who think that their homework is not interesting. It is discovered that students generally find homework difficult. It is seen that students think that homework requires skills, takes a lot of time, is tiring and causes stress.

Some direct quotes from students' opinions under these categories are given below:

S30: "*Some homework's contents such as slogan and acrostic push me very hard. These make me say 'What is it about?'.*"

S33: "*It was nice that you make us write questions. Even Though It sounded very simple, it was a homework that at least measure if we really understand the subject.*"

Categories		Codes
Positive Opinions	Learning	Strengthened the course. Gained strength in terminology. Provided repetition of the topic. Enabled better learning of topics. It was effective and useful in learning. Question preparation assignments were efficient.
	Easiness	It was not difficult.
	Permanence	Ensured permanence
	Attractiveness	It provided learning with fun. It was interesting and fun. It was done with love.
Negative Opinions	Learning	Acrostic, poetry, slogan, etc. were illogical, unnecessary, useless. I wish there were no homework. There should have been quizzes instead of homework. Homework should have been done during the course time. Homework should have been checked day by day. Homework was not useful.
	Easiness	Homework such as acrostic, poetry and slogan required creativity. Some homework was difficult. Doing homework every week was tiring. Homework took a lot of time. Homework was a burden. Homework was a stress factor.
	Attractiveness	Doing homework was not interesting. The homework was overwhelming

Table 10: Opinions about Homework

Opinions of the Students in the Second Group

The opinions of the students in the second group, where the activities were done in groups by reading the presentations without any lecture, are gathered under three categories which are "opinions about the design of the course", "opinions about the reading task" and "opinions about the activities".

Opinions on the Design of the Course

The opinions of the students in the second group regarding the design of the course were given in Table 11:

As can be seen in Table 11, students' opinions on homework are categorized under two categories as "positive opinions" and "negative opinions".

It is seen that students have positive and negative opinions about the design of the course. When sub-categories are examined, it is observed that students have mostly negative opinions about this method in terms of education, but they have mostly positive opinions about attractiveness. This situation shows that students find the way the course is taught is fun and interesting, but they are worried about not learning. While, in the first group, the opposite was true. It was seen that the students generally did not find the course interesting, but they thought it had a positive effect on learning. This situation shows that students have the idea that they learn better with the traditional method. It is also observed that students have positive opinions about this method that it provides active participation and free self-expression in the course.

Some direct quotes from students' opinions under these categories are given below:

S2: "*I had fun in some activities, I got bored in others, I did not understand why. This system did not contribute to the teaching of the course to me. I am a kind of person who understands better when teacher explains.*"

S4: "*Overall, it was a fun course. But my expectation was a little more homework-based curriculum. Nevertheless, I think I have reached a certain level of knowledge during this semester.*"

Opinions on Reading Assignment

The opinions of the students in the second group regarding the reading assignment given to them to understand the subject at the beginning of the course were given in Table 12.

As can be seen in Table 12, students' opinions about the reading task consist of only one category, "negative opinions".

It is seen that the students do not have a positive opinion about asking them to learn the subject by reading the documents given to them at the beginning of the course. It is noteworthy that all of the students' opinions on this issue are negative. The thing that the students complain the most is that the duration is not enough. In addition, it is observed that they were bothered since they had to read the documents within a certain period of time. Moreover, also observed that they think that they did not understand and did not learn the subject only through the document.

Some direct quotes from students' opinions under these categories were given below.

Categories		Codes
Positive Opinions	Learning	It was understandable and instructive. It was effective. I learned involuntarily. Topics are better structured in my mind. My creative thinking and productivity increased.
	Course Participation	I actively participated in the course. I was able to express myself freely.
	Attractiveness	It was a very interesting course / experience. I came to the course willingly with joy. It was fun and enjoyable. It was the first time in my life that I had such a course. It was student-centered. It was better than listening to the teacher with being bored. I did not understand how time passed.
Negative Opinions	**Learning**	Many subjects have been wasted. This process did not work in learning. We couldn't learn effectively and properly. It should have been based on giving lecture and homework. I would prefer the subject to be taught. We deflected from the focus. I had difficulties in learning. I prefer to listen teacher and take notes. Since there is exam, I would prefer subjects to be taught.
	Attractiveness	I was stunned and disliked because it was different than what we used to. I couldn't like the course. I did not have motivation to come and participate the course. I had no motivation.
	Responsibility	The structure of the course necessitated a teacher. Leaving the responsibility to the student did not make me happy.
	Applicability	We do not have enough capabilities for this application. It was not an appropriate processing in terms of class size and duration.

Table 11: Opinions on the Design of the Course

Categories		Codes
Negative Opinions	Limited Time	We could not finish reading the handed papers. The time given to read was insufficient. I can learn by reading one by one, I couldn't catch up. It is not appropriate to assume that everyone can to read at the same time.
	Designated Time	Reading a slide in a period of time put me in stress. Information should have been given before the course. Course notes should have been given in advance.
	Inability to Understand the Subject	I read without understanding. I have read just enough to do the activities. I could not understand the subject by reading. Without understanding the subject, we moved on to the activity. We couldn't get the necessary information just by reading the presentations.
	Other	Reading in pairs was not efficient.

Table 12: Opinions on Reading Assignment

S5: "*The problem for me was that the time was short. We read the form in a short period of time and started writing poem. I started writing poem before I could finish reading the form. Thus, I didn't get any yield.*"

S8: "*I think that more time should be given while reading the course notes. Because, performing the application before it was clearly understood and thinking about timing, caused both the application not to be understood and taking more time while the application was done.*"

Opinions About Activities

The opinions of the students in the second group regarding the activities were given in Table 13.

Categories		Codes
Positive Opinions	Learning	The activities were useful, provided learning. I learned the subject in class with activities. We learned how to use of methods and techniques.
	Participation	Even the student who never participated was actively involved.
	Permanence	During the finals week, I realized that the activities were permanent.
	Group Interaction	Group interaction was nice. I spoke / communicated with people I never spoke to. I united with my classmates.
	Attractiveness	The activities were fun. The activities were varied and beautiful.
Negative Opinions	Learning	Activities were like games, not like learning activities. The activities were not instructive / useful. There were no warnings or corrections in the activities. The activities were not instructive since the subject was not understood. The methods could not be used for learning purposes.
	Limited Time	Activities were rushed, they should have been done slowly. The time was short. The time could not be used properly / time was wasted.
	Attractiveness	Some activities were boring. We did not do the tasks willingly.
	Group Interaction	There was no respect for someone else's ideas. There were some problems in group works. Working as a group was not good. Everyone in the group did not fulfill their responsibilities. Some people in the group assumed the duties.
	Other	There was a lot of noise during the events. I felt uncomfortable reading the activities from the blackboard. Photocopying the activities was a problem.

Table 13: Opinions About Activities

As can be seen in Table 13, students' opinions on activities consist of two categories which are "positive opinions" and "negative opinions".

It is observed that students have positive and negative opinions about the activities. There are two different opinions that activities affect learning positively and they do not contribute to learning. It is seen that the students think that the activities are not instructive before the subject is understood adequately. One of the reasons for the negative opinions about the activities is that they were done in a limited time. Both giving reading assignment at the beginning of the course and having timing problem in the activities indicate that course time is not adequate for both course subject to be understood and activities to be completed.

Although there are positive opinions that it provides interaction for group work and provides an opportunity to socialize with classmates, it is striking that there are also some negative opinions.

Some direct quotes from students' opinions under these categories were given below:

S7: "*Yes, doing homework or activities as a group can be nice, but it is nice as long as everyone is aware of their responsibilities and respects the others ideas. I can say that I sometimes had minor problems in this regard.*"

S10: "*The activities were very fun… However, having limited course time caused some activities to be done in a hurry. So, it made me think we couldn't fully understand the subject.*"

Opinions of the Students in the Third Group

It is observed that opinions of students in the third group, where the flipped learning model was applied and the activities were done in groups are gathered under three categories which are "Opinions about the design of the course", "Opinions about pre-course studies" and "opinions about activities".

Opinions on the Design of the Course

The opinions of the students in the third group regarding the design of the course were given in Table 14:

Categories		Codes
Positive Opinions	Learning	These subjects could not be taught any better than this. The course was very efficient. We learned different methods and techniques. I discovered myself. We will collect the outcomes. It was more effective than normal course. A verbal course could be taught with application. When I studied for the exam, I saw that I already knew / learned well. My brain sizzled during the course, and it used all its functions. We learned without stress.
	Course Participation	We provided active learning. The course was interactive. The course was in the hands of the student. Everyone participated in the course effectively. Whether we wanted it or not, we attended the course. I was able to express myself.
	Permanence	Information was permanent. It remained in my mind when applied I saw that I remembered all of them while I was working on the final. I still remember them all.
	Responsibility	For the first time, I took notes in a course, and I kept a file. For the first time, I felt responsible.
	Attractiveness	I was like going to a meet my friends and have fun. I saw what could I do in a few hours. This course raised my expectation for the other courses. It was the most enjoyable, fun and beautiful course in this semester. I have never seen such a course execution before. The lesson satisfied me, I enjoyed it, I liked it. I am happy that I attended the course. There was no deficiency in the course. Other courses began to be boring. I saw that education can be loved. It was the most diverse, different and creative course I have ever seen. I feel myself lucky. I saw that you can have fun while learning. We did not realized how time passed.
	Diversity	Each course we used different methods and techniques. Using technology was an advantage.
Negative Opinions	**Learning**	I learn better individually. I have doubts about its benefit. I think we will get low score from the final exam. It could be learned better with the classical style. I couldn't learn very well. The technique did not work on us.
	Permanence	It was not permanent.
	Easiness / Difficulty	It was the most struggling course. It was difficult both materially and spiritually. Learning was up to us. Sometimes, I'm tired in the process.
	Other	There had to be a midterm and final exam. It was a course not suitable for absenteeism. Keeping files is a waste of paper. If there were weekly quizzes. Assigning homework in midterm week was not good.

Table 14: Opinions on the Design of the Course

As can be seen in Table 14, students' opinions on activities consist of two categories which are "positive opinions" and "negative opinions".

It is seen that students have positive and negative opinions about the design of the course. It is observed that about the learning, the students find the course efficient, they learn the subjects well, and they learn without stress. In addition, it is also seen that some students prefer individual learning, classical learning, plain lecturing and taking notes.

It is seen that the students find the course to be very positive in

terms of attendance. It is observed that students have positive opinions that they participate the course no matter if they want to or not, that they express themselves, that the course is given interactively, and that the course is in the hands of the students. The students think that the information is permanent and state that they feel a sense of responsibility in this course. It is noteworthy that the sub-category with the highest density is the attraction category. It is seen that the students liked the course and the conduction of the course. The students state that they had a lot of fun in the course, they were very surprised about the process, and they did not understand how time passed in the course. Students indicated that after this course, their expectations from other courses have increased, that other courses have started to be boring and that they see that with the help of this course education can be liked. These indications of the students showed how much they liked this course.

The difficulty of the course is the thing that students complain most. It is seen that some of the students think that the course is the most challenging, it is tiring and sometimes it is frustrating.

Some direct quotes from students' opinions under these categories were given below:

S1: "*Good thing, I learned this way. I discovered many areas where I was successful. Most importantly, we learned what group work is. Do you know that we worked shoulder to shoulder with many of our friends that we did not communicate, and learned all together?*"

S3: "*I am one of the most delighted with these activities. Because, I think the course should be in the student's hands and the course should be conducted by the student. And this course made me very satisfied in this sense.*"

Opinions about the Pre-Course Tasks

The opinions of the students in the third group regarding the pre-course tasks were given in Table 15:

Categories		Codes
Positive Opinions	Videos	I watched the places I don't understand again. Watching videos before coming to the class provided learning. The videos increased the efficiency. The videos enabled regular studying. Learning at home with videos was good in every respect. The learning environment at home was comfortable with videos. I watched the video as much as I wanted whenever I wanted.
	Homework	Homework was too much. Homework has contributed a lot to me. Homework made us come to course ready. Homework was useful. Homework was efficient. It was useful to give feedback on homework. Very good feedback was given to our homework. Reading the articles was enjoyable.
Negative Opinions	Videos	It was difficult to watch the videos in unfavorable dormitory conditions. Although it was good at first, it later became unbearable. It was not suitable for this course because it was verbal. Presentations should be given instead of videos. The more examples should have been given in the videos. If quizzes were done from videos. Presentations should also be given along with the videos.
	Homework	Regular homework mode forced me, and I was not accustomed to. Homework sometimes seemed like cruelty. Homework was too much and boring. Homework was done at the last moment / last day. Homework was tiring. I was yelling while doing homework. I felt lazy to do homework. I sometimes had trouble creating examples. I didn't like to summarize subjects. We said "homework again?".

Table 15: Opinions about the Pre-Course tasks

As can be seen in Table 15, students' opinions on activities consist of two categories which are "positive opinions" and "negative opinions".

Students have both positive and negative opinions about pre-course tasks. The students think that the videos given to take home were useful for learning. They also think that the videos allow them to watch them anytime, wherever they want, and watch them over and over again. It is observed that some of the students prefer presentations instead of videos to be given. They have some difficulties while watching the videos in the dormitory.

It is seen that in general, students find homework efficient and useful in terms of preparation and learning, but it is also seen that some students get tired, struggled and bored while doing homework.

Some direct quotes from students' opinions under these categories were given below:

S16: "*First of all, when I listened to the lecture videos and do homework every week beforehand, I would question the tasks we did as "Why do we do this?" But while I was studying for the exams on the final week, I realized that it really helped me a lot.*"

S19: "*Watching videos and doing homework before coming to course allowed us to work regularly… Homework was not difficult. So, it was not hard to do.*"

Opinions About Activities

The opinions of the students in the third group regarding the activities were given in Table 16:

Categories		Codes
Positive Opinions	Learning	Activities made a great contribution to learning. The activities were instructive. The activities were efficient. I learned easily through activities. The subject was strengthened well with the activities. I understood the subject better with the activities. What was learned at home was reinforced.
	Participation	Even when I came to the course feeling tired, I loved the activities. I am very happy to attend different activities.
	Attractiveness	It was fun to listen to friends' activities. The course became entertaining with activity. It increased my interest in the course. I have never done so much activity in my previous education life. The activities were very enjoyable, fun. I enjoyed the activities. With the activities, I did not understand how the course is finished. Methods and techniques were very good.
	Group Interaction	We exchanged ideas with friends. We strengthened friendship. We learned unity and solidarity with group work. We learned from each other with group work. We completed each other' weak sides as a group. It was easy to do activities as a group. I have established relationships with people I have never contacted. People with no relationship worked together. The communication of the class was very good.
Negative Opinions	**Learning**	Some activities were left unfinished. The activities were not instructive.
	Limited Time	The time given at the activities was very short. The activities were done very fast, it was a rush of breeding.
	Workload	The number of activities could have been smaller. The high number of activities prevented satisfaction. We were very tired with the activities.
	Attractiveness	We did the activities for necessity.

Table 16: Opinions About Activities

As can be seen in Table 16, students' opinions on the activities belonged to one of two categories, which are "positive opinions" and "negative opinions".

The students have both positive and negative views about the activities, but the positive views are decidedly high. Students generally think that the activities affected learning positively and strengthened what they learned at home. However, some students think that they could not learn through activities. It is observed that the students participated in the course through the activities and found the activities very attractive. Students think that the course became fun with the activities, that their interest in the course increased, and that they did not understand how the class ended while they were busy enjoying the activities.

It is seen that the most intense subcategory of activities is group interaction subcategory. The students think that the activities contributed to their exchanges of ideas, to mingling, to learning from each other, to unity and togetherness, and to socialization. The students also have some negative opinions about the duration of activities being short and the number of activities being high.

Some direct quotes revealing students' opinions within these categories are given below:

> S15: "*For the first time, I took notes in a course. I organized a file. I felt responsible for a course… Every topic remained in my mind with the activities you did. Although weeks have passed, I still remember.*"
> S29: "*I am sure that if we had done this course in a classical way, the information would not have been learned so easily and it would not have been so permanent. With the activities we did in the course, we coded each subject with something in our mind.*"

DISCUSSION

The following conclusions were reached regarding the effect of the models used on academic success:

First of all, it was concluded that there was no significant difference between the posttest success scores of the groups, that the students' levels of learning success were close to each other, and that the students in the whole group learned well. This shows that the three different applications arranged according to student-centered approaches had positive effects on success, although their levels were different. Other studies have shown that student-centered education increases students' academic achievement, increases their motivation to learn, increases the level of knowledge recall, and provides in-depth understanding (Kilic and Sahin, 2016; Maden, Durukan and Akbas, 2011; Salinas, Kane-Johnson and Vasil-Miller, 2008; Smart and Csapo, 2007).

It was also concluded that the standard deviation was smaller in the group in which the flipped learning model was applied compared to the other two groups. Senemoğlu (2011) stated that the fact that almost all of the students participated in the teaching showed that the quality of the teaching service was at a very good level, and the degree of students' participation in the teaching-learning process is the best indicator of the quality of teaching service. Furthermore, when students are able to participate in the teaching-learning process at the highest level, the majority of students learn at the highest level and their success levels are close to each other. This shows that the flipped learning model is effective on students' success. In terms of academic success, the flipped learning model and traditional classes have been the subject of many studies. In the literature, there are studies stating that flipped learning increases students' academic success (Asıksoy and Sorakın, 2018; Bishop and Verleger, 2013; Butt, 2014; Mason, Shuman and Cook, 2013; Okmen, 2020). Cho and Lee (2018) also reached the conclusion that this model has a positive effect on learning as a result of their meta-analysis study.

At the end of the present research, the results regarding the opinions of the students in the first group, where the lessons were taught through presentations interactively with the students, were as follows:

First, it was concluded that the students found the examples given in the lessons and the stories and memories that were shared interesting and good, and they thought they were effective in learning and beneficial in terms of permanence and reinforcement.

In the lessons designed as presentations, although memories and stories were told and different examples were given, it was concluded that some of the students were satisfied with this situation but some of them did not like the lessons, which they found to be long, tiring, and boring in terms of student participation and wanting to learn with activities. This shows that shared memories and stories are not enough for students to be sufficiently active and that the students wanted to be more active. Research has shown that the use of various activities in the educational environment increases student motivation (Okmen, 2020; Sirakaya, 2017; Su and Cheng, 2015; Yıldırım and Demir, 2016) and provides students with the opportunity to actively participate (Di Bitonto et al., 2014; Okmen, 2020; Rowkaya, 2017).

These students reported that they learned better with the traditional method and the students generally thought that this application was effective on their success although they did not find the lesson fun or interesting. This is the result of students' and teachers' traditional perceptions that they learn better through lecturing. In her study, Sahin (2020) determined that students' perceptions of education were mostly focused on "lecturing" and that traditional practices in lessons had a large place in their perceptions of learning.

Although some of the students thought that the homework assignments were unnecessary, difficult, stressful, and not interesting, other students thought that the homework offered the opportunity to repeat topics, reinforced the lessons, and contributed positively to learning. Considering that the classroom activities in the other two groups that held the students' attention were given as homework in Group 1, and that these students did not find this homework purposeful, especially the acrostics, poetry, and puzzle-style tasks, the importance of doing these activities in groups becomes clear. In addition, these types of homework were thought to have an important role in the academic success of the students in this group. Kaplan (2006) conducted a study to investigate whether homework assignments had an impact on students' levels of success and concept learning. According to the results of that research, homework had a positive effect on students' success and concept learning and also had a positive effect on students' attitudes towards the lesson. Similarly, Sarıgöz (2011) stated that when students did their homework on time, they reinforced the subjects that they studied at school, understood the subjects better, and were more motivated about the lessons.

The results of the opinions of the students in the second group, where the activities were done in groups by reading presentations without any lectures, were as follows:

First, it was concluded that they thought the lessons were fun and interesting with the activities, but they experienced learning anxiety because there was no lecturing. This showed that the students had the idea that they learned better with the traditional method and this also supports the results of the first group.

It was concluded that giving documents to the students and asking them to learn the subject by reading them in the classroom had negative effects and caused them anxiety about not learning. It was seen that because the reading and comprehension speeds of the students were different, it was not realistic to ask students to read and learn the subject in the classroom in a limited and insufficient amount of time, and it was not effective in learning. This also supported the effectiveness of learning the subjects in the flipped learning model in the home environment before the lesson, whenever the students wanted.

The students did not find activities done without understanding the subject instructive, and the short duration and the high number of activities made it difficult for the students to follow the activities and had a negative effect on their learning. The fact that there was a shortage of time both for the reading task given at the beginning of the lessons and for the activities indicates that the classroom time was not sufficient for both understanding the lesson and doing activities. This again emphasizes the effectiveness of performing the understanding-comprehension parts of the lessons at home before class and allocating more time for activities as in flipped learning.

The opinions of the students in the third group, where the flipped learning model was applied, were found to be as follows:

First, it was concluded that the students liked the lessons and the teaching of the lessons very much, found the lessons efficient, had fun in the lessons, and were surprised at how quickly time passed in class. This shows that the flipped learning model had a positive effect on students' attitudes towards the lessons. Numerous studies in the literature have also shown that the flipped learning model positively affects students' attitudes and motivations towards the lesson (Chen et al., 2015; Clark, 2015; Gross et al. 2015; Heyborne and Perrett, 2016; Ojennus, 2016; Okmen, 2020; Tawfik and Lilly, 2015).

The students found home videos and homework useful for lesson preparation and learning, and even if they felt forced and bored, they had positive thoughts about watching the videos whenever they wanted, watching them wherever they wanted, and watching them again and again. Although there are studies in the literature reporting that the obligation to work at home in the flipped learning model is a disadvantage of this model (Alsancak Sirakaya, 2015; Rowkaya, 2017; Turan and Goktas, 2015), a large number of students stated that the work done at home increased their active participation and success (Frydenberg, 2012; Herold et al., 2012; Okmen, 2020; Stone, 2012; Talbert, 2012).

The students also thought that the activities were effective in their learning and reinforced what they had learned at home, while the lessons became fun with the activities and increased their interest and participation in the lessons. The group studies contributed to their exchanges of ideas with their friends and helped them get to know each other, learn from each other, gain responsibility, build unity and togetherness, and socialize; the only negative situation related to the activities was the shortage of time. Studies show that methods that require students to work with each other increase students' achievements (Nam and Zellner, 2011; Okmen, 2020; Shy-Jong, 2007) and motivations (Arısoy, 2011; Okmen, 2020). Scott, Buchanan, and Haigh (1997) also stated that teaching practices in which the students are active, rather than the teacher, create more effective and permanent learning.

In the literature, it has been reported that there may be difficulties in classroom management and time management in classrooms where the flipped learning model is applied (Danisman et al., 2017) and that some students may not be able to complete their projects because the speed of the students to fulfill the tasks is not equal. For the same reason, some students may finish their projects early, and because they then have to wait in the classroom, they may become bored (Danisman et al., 2017; Thoms, 2012).

Based on the results obtained throughout this research, various suggestions can be presented. Some of them are as follows: The same research design could be repeatedly tested in different schools (private or government), with different participants and by different researchers. In-class practices should be prepared to keep students active and practicing, and to attract students' attention. Group activities should be included in the teaching process. Lectures should be enriched with different examples and stories. Teachers should enrich their general teaching styles with regard to their own subject areas. Homework should be assigned in a way that gives students the opportunity to repeat and reinforce subjects. Home tasks should be prepared to be completed within half an hour. Class tasks should be prepared while ensuring that they can be completed within the allotted period.

CONCLUSION

This research has shown us that different methods used according to the student-centered approach have positive effects on students' achievements. However, in the group for which the flipped learning model was applied, the majority of the students learned at a high level and their success levels were close to each other. This shows that a high quality of education was provided in this group.

Although the students found the examples, the stories, and the memories shared in the lectures to be interesting and good, these were not sufficient in terms of student participation, and the students preferred to learn via activities. In addition, the students had the perception that they learned better by the lecture method and this may be a result of the education system that they have grown up with.

It was seen that not enough time could be given to both lectures and activities, and activities performed without understanding the subject sufficiently were not found to be instructive by the students. This reveals the importance of the flipped learning model, which allows the "comprehension" step of the lesson to be carried out at home before the lesson and accordingly allows more time for activities in the lesson.

The flipped learning model positively affected the students' attitudes towards the course. The students liked the teaching of the lessons very much, had fun in the lessons, and were surprised at how quickly time passed. Group work allowed the students to exchange ideas with their friends, learn from each other, gain responsibility, build unity and togetherness, and socialize.

REFERENCES

Alsancak Sirakaya, D. (2015) *The effect of flipped classroom model on academic achievement, self-directed learning readiness and motivation.* Unpublished PhD thesis, Ankara: Gazi University.

Arısoy, B. (2011). *The effects of STAD and TGT techniques of cooperative learning on sixth grade students? academic achievement, retention and social skill levels in ?istatistic and probability? subject in mathematics lesson*. Unpublished master thesis, Adana: Cukurova University.

Asıksoy, G. and Sorakın, Y. (2018) 'The Effects of Clicker-Aided Flipped Classroom Model on Learning Achievement, Physics Anxiety and Students' Perceptions', *International Online Journal of Education and Teaching*, Vol. 5, No. 2, pp. 334-346.

Baepler, P., Walker, J. D. and Driessen, M. (2014) 'It's Not About Seat Time: Blending, Flipping, and Efficiency in Active Learning Classrooms', *Computers & Education,* Vol. 78, pp. 227–236. https://doi.org/10.1016/j.compedu.2014.06.006

Baltacı, A. (2018) 'A Conceptual Review of Sampling Methods and Sample Size Problems in Qualitative Research', *Journal of Bitlis Eren University Institute of Social Sciences*, Vol. 7, No. 1, pp. 231-274.

Benson, P. (2012) 'Learner-centered teaching', in A. Burns and J.C. Richards (ed.) *The Cambridge Guide to Pedagogy and Practice in Second Language Teaching*, Cambridge, UK: Cambridge University Press, pp. 30-37.

Bergmann, J. and Sams, A. (2012) *Flip Your Classroom: Reach Every Student in Every Class Every Day*, Washington, DC: Internal Society for Technology in Education.

Bishop, J. L. and Verleger, M. A. (2013) 'The Flipped Classroom: A Survey of the Research', *120th ASEE Annual Conference and Exposition*, Atlanta, GA.

Butt, A. (2014) 'Student Views on the Use of a Flipped Classroom Approach: Evidence From Australia', *Business Education and Accreditation*, Vol. 6, No. 1, pp. 33-43.

Buyukalan Filiz, S., Celik, S. and Toraman, C. (2018) 'Developing inclass question asking techniques scale (ICQATS)', *The Journal of Turkish Educational Sciences*, Vol. 16, No. 2, pp. 197-212.

Buyukozturk, Ş., Kilic Çakmak, E., Akgun, O. E., Karadeniz, S. and Demirel, F. (2013) *Bilimsel Araştırma Yöntemleri*. 15th ed. Ankara: Pegem Akademi.

Chen, S., She, J., Kameda, H. and Ohno, S. (2015) 'Implementation and Evaluation of Flipped Classroom in Chinese Language Course', *Proceedings of the Multidisciplinary Academic Conference*, pp. 1-8.

Cho, B. and Lee, J. (2018) 'A meta analysis on effects of flipped learning in Korea', *Journal of Digital Convergence*, Vol. 16, No. 3, pp. 59-73. https://doi.org/10.14400/JDC.2018.16.3.059

Clark, K. (2015) 'The Effects of the Flipped Model of Instruction on Student Engagement and Performance in the Secondary Mathematics Classroom', *The Journal of Educators Online*, Vol. 12, No. 1, pp. 1-115. https://doi.org/10.9743/JEO.2015.1.5

Daley, B. J. (2003) 'A Case for Learner-Centered Teaching and Learning', *New Directions for Adult and Continuing Education*, Vol. 98, pp. 23–30. https://doi.org/10.1002/ace.96

Danisman, Ş., Hasırcı Eriş, H.M., Kırcaburun, K., Boyacı, Z., Sahin, Ş., Okmen, B. and Kilic, A. (2017) 'Investigation of Flipped Learning Approach According to Expert Opinions', *Journal of Education and Practice*, Vol. 8, No. 26, pp. 81-90.

Demir, E., Saatcioğlu, Ö. and İmrol, F. (2016) 'Examination of Educational Researches Published in International Journals in Terms of Normality Assumptions', *Curr Res Educ,* Vol. 2, No. 3, pp. 130-148.

Di Bitonto P., Corriero N., Pesare E., Rossano V. and Roselli T. (2014) 'Training and Learning in e-Health Using the Gamification Approach: The Trainer Interaction' in Stephanidis C. and Antona M. (eds) *Universal Access in Human-Computer Interaction: Aging and Assistive Environment*, Springer, Cham. https://doi.org/10.1007/978-3-319-07446-7_22

Donovan, J. D. and Lee, S. Y. (2015) 'How We Flipped: Student and Instructor Reflections of a Flipped-Class Model in a Sensory Evaluation Laboratory Course', *NACTA Journal,* Vol. 59, No. 4, pp. 335-342.

Fraenkel, J. R., Wallen, N. E. and Hyun, H. H. (2019) *How to Design and Evaluate Research in Education*. New York: McGraw Hill Education.

Green, T. (2015) 'Flipped Classrooms: An Agenda for Innovative Marketing Education in The Digital Era', *Marketing Education Review*, Vol. 25, No. 3, pp. 179–191. https://doi.org/10.1080/10528008.2015.1044851

Gross, B., Marinari, M., Hoffman, M., DeSimone, K. and Burke, P. (2015) 'Flipped @ SBU: Student Satisfaction and the College Classroom', *Educational Research Quarterly,* Vol. 39, No. 2, pp. 36-52.

Frydenberg, M. (2012) 'Flipping Excel', *Proceedings of the Information Systems Educators Conference, New Orleans.*

Ha, Y. L. (2013) 'Who's the teacher? Who's the learner? Professional growth and development of a novice teacher in Hong Kong', *Childhood Education*, Vol. 90, No. 1, pp. 43–53. https://doi.org/10.1080/00094056.2014.872514

Hains, B. J. and Smith, B. (2012). 'Student-centered course design: Empowering students to become self-directed learners', *Journal of Experiential Education*, Vol. 35, No. 2, pp. 357-374. https://doi.org/10.1177/105382591203500206

Harvey, S. (2014) 'The "flipped" latin classroom: A case study', *Classical World,* Vol. 108, No. 1, pp. 117–127. https://doi.org/10.1353/clw.2014.0060

Herold, M. J., Lynch, T. D., Ramnath, R. and Ramanathan, J. (2012) 'Student and Instructor Experiences in the Inverted Classroom', *Frontiers in Education Conference (FIE*), 1-6.

Heyborne, W. H. and Perrett, J. J. (2016) 'To Flip or Not to Flip? Analysis of a Flipped Classroom Pedagogy in a General Biology Course', *Journal of College Science Teaching,* Vol. 45, No. 4, pp. 31-37. https://doi.org/10.2505/4/jcst16_045_04_31

Kaplan, B. (2006) *The Effect of Homework to Success of Students and Learning Concepts in Unit of Electricity Which Directs Our Life Style.* Unpublished master thesis, Istanbul: Marmara University.

Kilic, A., Aydın, M., Okmen, B. and Sahin, Ş. (2019) *Kuramdan Uygulamaya İhtiyaç Belirleme*. Ankara: Pegem Akademi.

Kilic, A. and Sahin, Ş. (2016) 'The Effects of Religious Culture and Moral Knowledge Course Organized with Student-Centered Approach on Students' Academic Achievement and Attitudes', *Journal of Theory and Practice in Education,* Vol. 12, No. 1, pp. 41-62.

Kubat, U. (2018) 'If There is Question, There is Learning Too', *Electronic Journal Of Social Sciences',* Vol. 17, No. 68, pp. 1585-1598. https://doi.org/10.17755/esosder.396548

Lazonder, A. W. and Harmsen, R. (2016) 'Meta-analysis of Inquiry-Based Learning: Effects of Guidance', *Review Of Educational Research*, Vol. 86, No. 3, pp. 681-718. https://doi.org/10.3102/0034654315627366

Leedy, P. D. and Ormrod, J. E. (2005) *Practical Research.* NJ: Pearson Education International.

Maden, S., Durukan, E. and Akbas, E. (2011) 'Primary School Teachers' Perceptions of Student Centered Teaching', *Mustafa Kemal University Journal of Social Sciences Institute,* Vol. 8, No. 16, pp. 255-269.

Mason, G., Shuman, T. R. and Cook, K. E. (2013). 'Inverting (Flipping) Classrooms Advantages and Challenges', *120th ASEE Annual Conference ve Exhibition*, Atlanta.

McCallum, S., Schultz, J., Sellke, K. and Spartz, J. (2015) 'An Examination of the Flipped Classroom Approach on College Student Academic Involvement', *International Journal of Teaching and Learning in Higher Education*, Vol. 27, No. 1, pp. 42-55.

Miles, M. B. and Huberman, A. M. (1994) *Qualitative Data Analysis: An Expanded Sourcebook*. 2nd edn. Thousand Oaks: Sage Publications.

Nam, C.W. and Zellner, R.D. (2011) 'The Relative Effects of Positive Interdependence and Group Processing on Student Achievement and Attitude in Online Cooperative Learning', *Computers & Education*, Vol. 56, No. 3, pp. 680–688. https://doi.org/10.1016/j.compedu.2010.10.010

Nemtchinova, E. (2007) 'Using technology with young English language learners'in Gordon, T., Fromberg, D. P. and Williams L. R. (eds) *Teaching Young Children a Second Language*, Connecticut: Praeger.

Neuendorf, K. A. and Kumar, A. (2002) 'Content Analysis', *The International Encyclopedia of Political Communication*, pp. 221-230. https://doi.org/10.1002/9781118541555.wbiepc065

Ojennus, D. D. (2016) 'Assessment of Learning Gains in a Flipped Biochemistry Classroom', *Biochemistry and Molecular Biology Education*, Vol. 44, No. 1, pp. 20–27. https://doi.org/10.1002/bmb.20926

Okmen, B. (2020) *Developing the instructional process in layered flipped learning model.* Unpublished PhD thesis, Duzce: Duzce University Institue of Social Sciences.

Rodriguez-Valls, F. and Ponce, G. (2013) 'Classroom, the we space: Developing studentcentered practices for second language learner (sll) students', *Education Policy Analysis Archives*, Vol. 21, No. 55, pp. 1-22. https://doi.org/10.14507/epaa.v21n55.2013

Sahin, Ş. (2020). *Compassionate love, democracy and student centered education perceptions of students, teachers and school principals.* Unpublished PhD thesis, Duzce: Duzce University Institue of Social Sciences.

Salinas, M. F., Kane-Johnson, S. E. and Vasil-Miller, M. A. (2008) 'Long-term Learning, Achievement Tests, and Learner Centered Instruction', *Journal of the Scholarship of Teaching and Learning*, Vol. 8, No. 3, pp. 20–28.

Sams, A. and Bergmann, J. (2013) 'Flip Your Students' Learning', *Educational Leadership*, Vol. 70, No. 6, pp. 16-20.

Sarıgöz, O. (2011) 'Assessment of the Thoughts of Secondary Education Students about Homeworks Given in Chemistry Lesson', *Electronic Journal of Vocational Colleges*, Vol. 1, No. 1, pp. 80-87.

Scott, J., Buchanan, J. and Haigh, N. (1997) 'Reflections on Student-Centered Learning in a Large Class Setting', *British Journal of Educational Technology*, Vol. 28, No. 1, pp. 19-30. https://doi.org/10.1111/1467-8535.00003

Senemoğlu, N. (2011) *Kuramdan Uygulamaya Gelişim Öğrenme ve Öğretim*, Ankara: Pegem Akademi Yayıncılık.

Shy-Jong, J. (2007) 'A Study of Students Construction of Science Knowledge: Talk and Writing in a Collobrative Group', *Educational Research*, Vol. 49, No. 1, pp. 65-81. https://doi.org/10.1080/00131880701200781

Sirakaya, D. A. (2017) 'Student Views on Gamified Flipped Classroom Model', *Ondokuz Mayis University Journal of Faculty of Education*, Vol. 36, No. 1, pp. 114-132. https://doi.org/10.7822/omuefd.327393

Smart, K. L. and Csapo, N. (2007) 'Learning by Doing: Engaging Students Through Learner-Centered Activities', *Busines Communication Quarterly*, Vol. 70, No. 1, pp. 451-457. https://doi.org/10.1177/10805699070700040302

Stone, B. B. (2012) 'Flip Your Classroom to Increase Active Learning and Student Engagement', *28th Annual Conference on Distance Teaching & Learning*, Wisconsin: The Board of Regents of the University of Wisconsin System.

Su, C. H. and Cheng, C. H. (2015) 'A Mobile Gamification Learning System for Improving the Learning Motivation and Achievements', *Journal of Computer Assisted Learning*, Vol. 31, No. 3, pp. 268-286. https://doi.org/10.1111/jcal.12088

Talbert, R. (2012) 'Inverted Classroom', *Colleagues*, Vol. 9, No. 1, pp. 1-3.

Tawfik, A. A. and Lilly, C. (2015) 'Using a Flipped Classroom Approach to Support Problem Based Learning', *Tech Know Learn*, Vol. 20, pp. 299-315.

Thoms, C. L. (2012) 'Enhancing the Blended Learning Curriculum by Using the Flipped Classroom Approach to Produce a Dynamic Learning Environment', *Iceri2012 Proceedings*, pp. 2150-2157.

Tucker, B. (2012) 'The Flipped Classroom: Online Instruction at Home Frees Class Time for Learning', *Education Next*, Vol. 12, No. 1, pp. 82.

Turan, Z. and Goktas, Y. (2015) 'A New Approach in Higher Education: The Students' Views on Flipped Classroom Method'. *Journal of Higher Education and Science*, Vol. 5, No. 2, pp. 156-164. http://dx.doi.org/10.5961/jhes.2015.118

Vernon, D.T. and Blake, R.L. (1993) 'Does Problem-Based Learning Work? A Meta-Analysis of Evaluative Research', *Academic Medicine*, Vol. 68, No. 7, pp. 550-563. http://dx.doi.org/10.1097/00001888-199307000-00015

Yıldırım, İ. and Demir, S. (2016) 'Students' Views about Gamification Based Curriculum for the Lesson of Teaching Principles and Methods', *International Journal of Curriculum and Instructional Studies*, Vol. 6, No. 11, pp. 85-101.

Full research paper

UNIFICATION OF MULTIMEDIA WITH TECHNIQUES OF ART AND VEDIC APHORISMS FOR DEVELOPMENT OF MATHEMATICAL SKILLS: A STUDY OF INDIAN AND UK SCHOOL STUDENTS

Surinderjit Kaur Bawa[1]✉
Rekha Kaushal[2]
Jaswinder Kaur Dhillon[3]

[1]Central university of Punjab, Bathinda, India

[2]G D Goenka University, Gurugram, India

[3]University of Worcester, United Kingdom

✉ sk_bawa2001@yahoo.co.in

ABSTRACT

Multimedia programs having a number of elements like Texts, spoken words, sound & music, graphics, animations and still pictures provide different stimuli in their presentations. Art is the field of education that provides a platform for rigorous investigation, representation, expression, and reflection of both scholastic content and the art form itself. The integration of art with other subjects of the school curriculum can open new pathways of learning for students. Vedic Mathematics is an approach to resolve the crisis in education especially in the field of mathematics. It is not simply a collection of new computational techniques; rather, it provides an entirely different approach to the mathematical computation based on pattern recognition. The present paper deals with the development of multimedia packages using techniques of art and Vedic aphorisms on some selected common topics of curriculum of UK and Indian elementary mathematics and the effectiveness of multimedia packages for the development of mathematical skills. The study was conducted using quasi experimental design for research in both countries. The quantitative analysis of data revealed that the multimedia packages developed by using techniques of art and Vedic Aphorisms have significantly improved the mathematical skills of UK elementary school students.

KEYWORDS

Mathematical skills, multimedia, techniques of art, Vedic aphorisms

HOW TO CITE

Bawa S. K., Kaushal R., Dhillon J. K. (2020) 'Unification of Multimedia with Techniques of Art and Vedic Aphorisms for Development of Mathematical Skills: A Study of Indian and UK School Students', *Journal on Efficiency and Responsibility in Education and Science*, vol. 13, no. 3, pp. 130-139. http://dx.doi.org/10.7160/eriesj.2020.130303

Article history
Received
December 24, 2019
Received in revised form
June 30, 2020
Accepted
August 12, 2020
Available on-line
September 30, 2020

Highlights

- *Development of Mathematical Skills with techniques of art and Vedic aphorisms using quasi experimental design.*
- *Multimedia packages developed by using techniques of art and Vedic aphorisms have not been found to be effective in development of mathematical skills of Indian elementary school students.*
- *Techniques of Art when integrated with multimedia have significant effect on the development of mathematical skills of elementary school students of UK.*
- *Multimedia packages with Vedic aphorisms are not effective to develop mathematical skills of UK elementary school students*

INTRODUCTION

Learning through embedded multimedia proves to be superior to the learning in verbal conditions. Lessons or instructions provided by multimedia technology are preferred by learners as well as instructors for better and improved classroom results. All the students have access to technology these days. Computers, internet, cell phones are available all the time for students inside as well as outside the classroom. They speak to others in the language of technology and they are expected to do the same inside the classroom and get the best out of it.

The use of multimedia in the classroom can significantly enhance student's achievements if systematically designed and implemented. Students use the information provided to them through visual and auditory presentations to construct knowledge. Experimental research studies done on multimedia as a strategy to facilitate teaching in the classrooms explored that it helps in imparting the educational material to students effortlessly and has enhanced the trend to use technology and multimedia in education (Ghazzawi, 2002:15). Multimedia has also showed a positive impact on development of cognitive abilities, academic success, understanding and application. Learning through multimedia is always a major concern for mathematics teachers. The mathematical symbols are abstract in nature. Therefore, students cannot realize the characteristics and meanings of these symbols, and then it becomes unreasonable to ask students to recount their arithmetic calculations. As technology is progressing continuously, teaching mathematics using different tools of multimedia is becoming a new and improved way of instruction (Malik and Aggarwal, 2012: 468). Learning is enhanced by the use of multimedia tools like visuals, sound, text and motion. Making use of these visual representations to teach mathematical skills produce positive results for the learner (Flanagan, 2002).

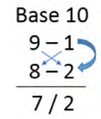
A newspaper article by Clark (2012) reported that there is a mathematics crisis in the UK and the universities are closing down those degree courses which require mathematical skills. The report also revealed that England is one of the few developed countries that are failing to educate their students in mathematics at elementary stage. The authors visited the elementary schools of UK, the teachers of those schools shared that students lack their interest in mathematics and many a times their total achievement gets affected by achievement in mathematics. In Indian elementary schools, the same condition was also prevailing, where the students refused to choose mathematics even at secondary level due to lack of interest in mathematics. After understanding the condition of elementary mathematics in both the countries, authors thought to develop a multimedia package to develop interest and enhance achievement of the students in mathematics using art and vedic aphorisms. The multimedia packages were developed taking into consideration whether these proved systems would be effective in India and UK having different systems of education.

REVIEW OF LITERATURE

Over the last few years, a number of researches have been conducted to investigate the impact of using multimedia tools in learning. Multimedia is a combination of auditory / verbal and visual/pictorial material presented in a systematic way (Mayer, 2012). It may include power point presentation that strengthens deeper understanding using graphics and onscreen text (Mayer and Johnson, 2008: 385), virtual games, computer assisted instructions and multimedia in combination with structured guidance and moreover, reflection technique can foster potentially deep understanding of inexperienced learners (Moreno and Mayer, 2004: 172; Moreno and Mayer, 2005: 127). These multimedia strategies can be used in any content area. Presentation of verbal and visual material e.g. videos integrated with exchanges of ideas are most effective for beginners and learners who learn from visuals. That is why the lessons incorporated with effective video clips are more appropriate for slow learners and under achievers for teaching complex topics and for introductory courses. Undoubtedly all other students and subjects are benefited as well.

The research findings on the effectiveness of videos clips embedded multimedia in classes are very motivating. A number of studies in the specific areas have produced significant results which favors the use of multimedia in classroom teaching (Seago, 2015: 259; Wang and Hartley, 2003:105; Brophy, 2004; Moreno and Valdez, 2007: 194; Borko et al., 2008: 417; Pryor and Bitter, 2008: 2668). Stimuli presented by multimedia using auditory and visuals increases retention, promotes deeper understanding and comprehensive learning.

Vedic Mathematics is the name given to that system in which, mathematics is based on 16 sutras, which are also known as aphorisms. The whole system of Vedic mathematics is interrelated and unified because the most important feature of Vedic mathematics is coherence. This unifying quality makes mathematics easy, pleasurable and encourages uniqueness. The teachers should use sutras or aphorisms of Vedic Mathematics in mathematics class along with other methods which will definitely benefit the students to achieve better and solve the problems in short time. An example of vedic mathematics with the use of one of its aphorisms for multiplication is cited here. The name of the aphorism is '*Nikhilam Sutra'* as given in Indian Vedas. If one wants to multiply 9 with 8, mentally using this aphorism, it is done by choosing a nearest base (base will be the multiple of 10). For these two numbers (9 and 8), base will be 10. Then, the numbers are to be subtracted from the base and write the difference beside the number with minus sign as follows. Then, multiply the right-hand side numbers vertically and write the product below. After this, cross subtract the numbers and the difference below on left hand side as given below:



The Nikhilam Sutra could be extremely helpful for the multiplication of bigger numbers also which are near to the base of multiples of 10.

There is significant reduction in the time duration to solve the problems using Vedic mathematics in basic arithmetic calculations (Krishna Prasad, 2017: 161). Vedic Aphorisms improve the computational skills of the learners in a wide area of problems, ensuring both speed and accuracy because it is strictly based on rational and logical reasoning. Vedic mathematics has proved to put a positive impact on students' performance (Ismail and Sivasubramniam, 2010: 133). The students succeed in completing the long multiplication problems involving tables more than five times correctly after learning the Vedic method. Katgeri (2017: 6772) found that a greater number of problems have been solved by the students accurately with significantly less errors with the use of Vedic mathematics in comparison to traditional method of teaching this subject. Vedic mathematics also improves the skills of concentration and rational thinking which are the vital needs of mathematical training for competitive examinations (Dani, 1993: 236). The knowledge of such methods enables the teachers to be more resourceful to mend the students and improve their talent and creativity.

Schools integrating the arts into the curriculum as part of comprehensive education reform strategy are documenting positive changes in the school environment and student performance (Richard, 2002). The students who are taught with arts possess a greater level of motivation and show regularity in class and become more creative than those students who are not exposed to art activities in the school. Use of arts in the classroom as a way of teaching students opens up the pathways for their success both in the classroom and outside world that lasts for the lifetime (Melnick, Witmer and Strickland, 2011: 154). When art and other creative activities are combined with mathematics, it gives learners and teachers to interact creatively and makes mathematics a subject of inquiry (Björklund and Björkman, 2017: 13). Education of mathematics through art and lively activities is an effective way to get one's hand on between mathematics attitudes and joy of learning and support the students in their achievements in the subject of mathematics (Fenyvesi, Koskimaa and Lavicza, 2017: 107). Creating visual illusions through playful and artistic procedures, holds an exciting pedagogical opportunity for raising students' attention towards mathematics. Mathematics is a subject that always seems to be difficult and boring for most of the students but teaching mathematics can be made interesting and retainable in the minds of pupils using different innovative approaches. One of these approaches is teaching mathematics using techniques of art. Integrating the arts into mathematical experiences bring a creative and enjoyable quality to the learning and often makes it more comprehensible for those who are less inclined towards math. Moreover, Integration of art in teaching and learning process has turned up at frontline in response to the regular deterioration of scores of students (Harlin and Brown, 2007: 3). Artistic process means one makes, does and creates something real. Likewise, these are the most realistic experiences which are essential to learn and enjoy math. If one proceeds from the premise that artistic experiences significantly enhance learning, needless to say then, that students' understanding and appreciation for math will be deepened when it is presented to them in an artistic way. Arts become the encouraging factor of learning when it relates to the basic part of the curriculum as well as Integration of art in teaching makes students enable to effortlessly understand the subject matter, ideas and concepts by connecting discrete curricula with the arts (Fowler, 1996; Krug and Cohen-Evron, 2000: 285). Art brings enjoyment to the lives of those who embrace it. Moreover, the use of painting, dance, theatre, poetry in the mathematics teaching and learning makes its more interesting.

A report by Clark (2012) explains that sub standards of mathematics education from decades had led to a crisis in number skills among students in England and due to this universities are dropping mathematics from their degree courses because the students as well as lecturers are incapable to manage their mathematical skills. The report also claimed that complex problems of mathematics are not easy for the students to tackle with and their teachers are also struggling to teach them mathematics anyway. The reasons for not studying mathematics at A-level were perceived as difficulty in learning and the lack of confidence. These are the main reasons for dropping the subject for most of the students. Apart from these, dislike, boredom and lack of relevance are the other important reasons (Brown, Brown and Bibby, 2008: 3). After looking at mathematics education in other countries, the lessons and qualifications in English schools were 'not fit for purpose'. The report also said that England is just one of the developed nations that fail to educate students in mathematics until the age, that student enters a university. In England, as claimed by the report, only 15 percent students study mathematics as a subject after the age of 16, apart from GCSE candidates who take re-examination in the subject to boost their grades.

Mathematics knowledge and qualifications are increasingly important gateways to further and higher education, for crucial life-skills and in order to respond to economic change, as per the report, But the way mathematics is taught and assessed in England has not always kept pace with these changes or with the needs of learners and has left one in four adults functionally innumerate (Clark, 2012). Educational technology applications for enhancing mathematics achievement in K-12 classrooms using meta-analysis approach also explored problems with previous reviews (Cheung and Slavin, 2013: 88). In the last few decades, undoubtedly, educational technology has benefited the students in mathematics classrooms, but the results are to be interpreted cautiously.

A great deal of differences exists with the procedures of research, inclusion of technology in analysis, as serious methodological problems exist with the evaluation of technology application in mathematics classroom. Some of the other common problems are non-existence of control group, lack of initial equivalence between control and experimental groups, large pretest differences; even with the use of ANCOVA (Analysis of Covariance), the underlying distributions may be fundamentally different, therefore large pre-test difference cannot be adequately controlled (Shadish, Cook and Campbell, 2002) and questionable outcome measures. It is indeed unfortunate that poor methodologies tend to report much higher effect size than those with more rigorous methods (Slavin and Smith, 2009: 500; Slavin and Madden, 2011: 370). The participation rate of the students after 16 and university entrance level mathematics is low across the UK and this has been considered as a serious problem (Noyes and Sealey, 2012; Hillman, 2014). There are few studies that explored that perceived difficulties and lack of confidence are the main reasons for students of the UK to drop out mathematics after their General Certificate of Secondary Education (GCSE) qualification (Brown, Brown and Bibby, 2008: 14). However, Indian education system and learning environment for teaching and learning of mathematics also need significant improvements as difficulties in mathematics begin at an early stage because some students enter in schools with limited amount of number sense (Kaufmann, 2008: 1).

Mathematical skills at elementary level has been recognized as most important skill to become successful in the world of work today at many places around the world. There is a significant gap between the knowledge and skills the students learn in school and the knowledge and skills workers need in workplaces and communities. Therefore, teachers need to promote conceptual understanding by using manipulatives to teach mathematical skills (Maccini and Gagnon, 2000: 2; 2006: 217). Preparation of teaching learning material has emerged as an important factor within school for the development of skills in this subject because change and improvement in the context of using technology in learning environments invite participation, engage children, and offer a sense of success. But the situation is intensified by the fact that most of the teachers lack skills of using technology effectively in their classrooms and the resistance of some teachers towards innovative changing and their persistence in managing of their classes with traditional teaching and learning methods (Tramonti, 2018: 1492). This leads to the under development of the required skills making it an abstract subject and lack of connection of its immediate application in everyday life jeopardizing the importance of connection between scientific topics and reality (Ausubel, 1990). Amalgamation of technology with Vedic aphorisms and art techniques is an interesting way to develop the mathematical skills of the students of elementary classes. The study has been conducted to achieve the following objectives:

1. To develop mathematical skills among Indian elementary school students and elementary school students of UK using techniques of art through multimedia packages.
2. To explore the effectiveness of multimedia packages developed using Vedic Aphorisms for enhancing mathematical skills of Indian elementary school students and elementary school students of UK.
3. To compare the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using techniques of art.
4. To compare the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using Vedic aphorisms.

Thus, the objectives of the present study are framed to explore the effectiveness of multimedia packages developed by using techniques of art and Vedic aphorisms and to compare the development of mathematical skills of Indian and UK elementary school students with multimedia packages, the paper addressed the following hypothesis:

1. Mathematical skills of Indian elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms.
2. Mathematical skills of UK elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms.
3. There will be no significant difference in the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using techniques of art.
4. No significant difference will exist in the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using Vedic aphorisms.

MATERIAL AND METHODS

Design and Sample

The study was conducted using Quasi experimental design. The data comprised of 180 students of three elementary schools from UK and India each. 90 students from each country were selected. 30 students from each school of UK and India were the participants of the present study. The grade of students selected for the experiment were 6, 7 and 8 in India and key stage 3 in UK where students are studying in year 7, 8 and 9. Therefore, common grades were decided as 7 and 8 for the present study who are in the age group 11 to 13 years. Students were selected randomly from these school having diversity of students as far their achievement level is concerned. Common topics from the existing mathematics curriculum of both the countries applicable for the age group 11-13 years were selected. First school was taken as control group, second school as experimental group I in which techniques of Art were applied and third school was taken as experimental group II in which Vedic Aphorisms were applied for teaching math in India as well as UK.

Instruments

The multimedia packages using techniques of art and Vedic aphorisms on 6 selected topics of elementary mathematics which were common to Indian and UK curriculum of mathematics for elementary classes & Mathematical Skills Test for elementary school students of India and UK were constructed and standardized by the investigator.

RESULTS

Effectiveness of Multimedia Package using Techniques of Art and Vedic Aphorisms for developing Mathematical Skills among students in India

To find out the effectiveness of multimedia packages using techniques of art and Vedic aphorisms for Indian elementary school students to develop their mathematical skills, the investigator administered a pretest of mathematical skills of elementary students studying in Indian schools. The students were taught topics of elementary mathematics with multimedia packages using techniques of arts and Vedic aphorisms which was then followed by a post-test of mathematical skills. Descriptive statistic for the control and experimental groups has been presented in table 1 and table 2 reveals the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
Control Group (IC)	9.43	2.694	23
Experimental Group with multimedia packages using techniques of art (IEA)	9.72	2.851	25
Experimental Group with multimedia packages using Vedic (IEV)	6.76	2.851	17
Total	8.85	2.954	65

Table 1: Effectiveness of Multimedia Packages vis a vis Mathematical Skills (India) - Descriptive Statistics, 2019 (Source: own Calculation)

Table 1 depicts that the values of mean and standard deviation of control group are 9.43 and 2.694 respectively, mean and standard deviation of experimental group which was given intervention with multimedia packages using techniques of art are 9.72 and 2.851 respectively and mean and standard deviation of experimental group which was taught with multimedia packages using Vedic aphorisms are 6.76 and 2.538. To covariate the initial scores of Indian elementary school students on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 2.

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	134.51	1	134.51	25.38	<0.001
Main Effect (Treatment)	12.40	2	6.20	1.17	0.317
Explained	323.24	64	5.29		
Residual	5645.00	65			
Total	558.46	64			

Table 2: Effectiveness of Multimedia Packages vis a vis Mathematical Skills for Indian Students, 2019, (Source: own calculation)

It is revealed from the above results that *F* value of 'Method' comes out to be 1.17 and significant value is 0.317. It indicates that significant difference does not exist in mathematical skills of Indian elementary school students with multimedia packages developed by using techniques of art and Vedic aphorisms. The hypothesis which stated that **mathematical skills of Indian elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms** has been rejected. Therefore, multimedia packages developed by using techniques of art and Vedic aphorisms have not been found to be effective for development of mathematical skills of elementary school students of India.

It may be interpreted that multimedia packages developed by using techniques of art and Vedic aphorisms do not have significant effect on development of mathematical skills on Indian elementary school students.

Effectiveness of Multimedia Package using Techniques of Art and Vedic Aphorisms for developing Mathematical Skills in UK

To find out the effectiveness of multimedia package using techniques of art and Vedic aphorisms to develop the mathematical skills of elementary school students of UK, the pretest of mathematical skills was administered on elementary students studying in schools of UK. After the pretest, students were taught topics of elementary mathematics with multimedia packages using techniques of arts and Vedic aphorisms which was then followed by a post-test of mathematical skills. Descriptive statistic for the control and experimental groups has been presented in table 3 and table 4 reveals the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
Control Group (UC)	10.76	1.690	25
Experimental Group with multimedia packages using techniques of art (UEA)	11.63	2.297	30
Experimental Group with multimedia packages using Vedic (UEV)	9.05	3.031	22
Total	10.61	2.566	77

Table 3: Effectiveness of Multimedia Packages vis a vis Mathematical Skills (UK)-Descriptive Statistics, 2019, (Source: own calculation)

Table 3 shows that the values of mean and standard deviation of control group (UC) are 10.76 and 1.690 respectively, mean and standard deviation of experimental group I (UEA) are 11.63 and 2.297 respectively and mean and standard deviation of experimental group II (UEV) are 9.05 and 3.031. To covariate the initial scores of UK elementary school students on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 4.

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	96.338	1	96.338	22.105	<0.001
Main Effect (Treatment)	57.523	2	28.761	6.600	0.002
Explained	318.143	73	4.358		
Residual	9169.00	77			
Total	500.312	76			

Table 4: Effectiveness of Multimedia Packages vis a vis Mathematical Skills for UK Students, 2019, (Source: own calculation)

It is revealed from table 4 that *F* value of 'Method' comes out to be 6.600 and significant value 0.002 < 0.01 which is significant at 0.01 level of significance which shows the existence of significant difference in mathematical skills of UK elementary school students of Control group (UC), experimental group I (UEA) and experimental group II (UEV). The hypothesis which stated that '**mathematical skills of UK elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms**' has been accepted. Therefore, multimedia packages developed by using techniques of art and Vedic aphorisms have been found to be effective for development of mathematical skills of elementary school students of UK.

It can be interpreted that multimedia packages developed by using techniques of art and Vedic aphorisms have significant effect on the development of mathematical skills among elementary school students of UK. The findings also reveal that significant value for pre-tests of mathematical skills is <0.01 which means that the difference in Pre-test scores of mathematical skill test have significant effect on experiment manipulation. Therefore, it is obligatory to do the post hoc analysis to find the actual difference between post-test of UC, UEA and UEV. Table 5 shows the post-hoc analysis.

Name of the Group	Name of the Group	Mean Difference	Std. Error	Significance value
UC	UEA	0.967	0.566	0.090
	UEV	1.186	0.621	0.060
UEA	UC	0.967	0.566	0.090
	UEV	2.153*	0.593	0.001
UEV	UC	1.186	0.621	0.060
	UEA	2.153*	0.593	0.001

** significant at 0.01 level of significance*

Table 5: Pairwise Comparison- Dependent Variable: Post Test Scores of Mathematical Skills Test, 2018-2019, (source: own calculation)

Table 7, indicates that mean difference between control group (UC) and experimental group I (UEA) is 0.967, control group (UC) and experimental group II (UEV) is 1.186 and experimental group I (UEA) and experimental group II (UEV) is 2.153. The significant value of UC and UEA is 0.09 > 0.05 which is not significant at 0.05 level of significance, the significant value of UC and UEV is 0.060 > 0.05 which is not significant at 0.05 level of significance whereas the significant value of UEA and UEV is 0.001 < 0.01 which is significant at 0.01 level of significance.

By comparing the means of UEA and UEV, it can be interpreted that multimedia packages developed by using techniques of art are more effective in developing the mathematical skills of UK elementary school students as compared to multimedia packages developed by using Vedic Aphorisms.

Comparison of Mathematical Skills of India and UK students with Multimedia Packages using Techniques of Art

To compare mathematical skills of elementary school students of India and UK with multimedia packages developed by using Techniques of Art, a pretest of mathematical skills was administered by the investigator on elementary students studying in schools of UK and India. Then, the students were taught topics of elementary mathematics with multimedia packages using techniques of arts and followed by a post-test of mathematical skills. Scores of pre-test and post-test of both the experimental groups were calculated and tabulated. The descriptive statistic for experimental group (India) IEA and experimental group (UK) UEA has been presented in table 6 and table 7 reveals the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
IEA	9.72	2.851	25
UEA	11.63	2.297	30
Total	10.76	2.715	55

Table 6: Comparison of Mathematical Skills of Indian & UK students viz a viz Techniques of Art- Descriptive Statistics, 2019 (Source: own Calculation)

Table 6 explains that the values of mean and standard deviation of IEA are 9.72 and 2.851 respectively, mean and standard deviation of UEA 11.63 and 2.297 respectively. To covariate the initial scores of Indian and UK elementary school students

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	64.721	1	64.721	11.880	0.001
Main Effect (vis-à-vis Country)	53.258	1	53.258	9.776	0.003
Explained	283.286	52	5.448		
Residual	6770.000	55			
Total	3.927	54			

Table 7: Mathematical Skills (India and UK) viz a viz Techniques of Art – ANCOVA results, 2019 (Source: own Calculation)

on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 7. It is clear from the above table that *F* value against 'Country' comes out to be 9.776 and sig. value is 0.003 < 0.01 which is significant at 0.01 level of significance. It implies that there exists significant difference in mathematical skills of elementary school students of IEA and UEA. The hypothesis which stated that '**no significant difference in mathematical skills of Indian and UK elementary school students with multimedia packages developed by using techniques of art**' has been rejected. Therefore, it can be interpreted from the above findings that development of mathematical skills of Indian and UK elementary school students with multimedia packages using techniques of art differs significantly.

Table 9 also reveals that significant value for pre-tests of mathematical skills of IEA and UEA is 0.001 < 0.01 which means that the differences in initial scores (Pre-test scores of mathematical skills test) of IEA and UEA have significant effect on experiment manipulation. The post hoc analysis has been presented in table 8.

Name of the Group vis-à-vis Country	Name of the Group vis-à-vis Country	Mean Difference	Std. Error	Significance value
IEA	UEA	1.977*	0.632	0.003
UEA	IEA	1.977*	.632	.003

** Significant at 0.01 level of significance*

Table 8: Pairwise Comparison- Dependent Variable: Post Test Scores of Mathematical Skills Test, 2019, (source: own calculation)

From table 8, it is observed that mean difference between IEA and UEA is 1.997. The significant value of IEA and UEA is 0.003 < 0.01 which is significant at 0.01 level of significance. By comparing the means of IEA and UEA, it can be construed that multimedia packages developed by using techniques of art have improved the mathematical skills of UK elementary school students than to Indian elementary school students.

Comparison of Mathematical Skills with Multimedia Packages developed by using Vedic Aphorisms (India and UK)

To compare the mathematical skills of elementary school students of India and UK with respect to multimedia packages of Vedic Aphorisms, a pretest of mathematical skills was administered by the investigator on elementary students studying in schools of UK and India. After the pretest, students were taught the topics of elementary mathematics with multimedia packages developed using Vedic Aphorisms, which was then followed by a post-test of mathematical skills. Scores of pre-test and post-test of both the experimental groups were calculated and tabulated. The descriptive statistic for experimental group (India) IEA and experimental group (UK) UEA has been presented in table 9 and table 10 discloses the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
Indian Exp withV	6.76	2.538	17
Uk Exp withV	9.05	3.031	22
Total	8.05	3.017	39

Table 9: Descriptive Statistics of Mathematical Skills of Indian and UK Students viz a viz Vedic Aphorisms 2019 (Source: own Calculation)

From table 9, it is clear that the values of mean and standard deviation of IEV are 6.76 and 2.538 respectively, mean and standard deviation of UEV 9.05 and 3.031 respectively. To covariate the initial scores of Indian and UK elementary school students on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 10.

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	103.069	1	103.069	19.231	0.000
Main Effect (vis-à-vis Country)	14.572	1	14.572	2.719	0.108
Explained	192.945	36	5.360		
Residual	2874.000	39			
Total	345.897	38			

Table 10: Mathematical Skills (India and UK) viz a viz Vedic Aphorisms- ANCOVA results, 2019 (Source: own Calculation)

Table 10 reveals that *F* value against 'Country' comes out to be 2.719 and significant value is 0.108 > 0.05, which is not significant at 0.05 level of significance. It infers that there does not exist significant difference in mathematical skills of elementary school students of IEV and UEV. The hypothesis which stated that '**no significant difference will exist in mathematical skills of Indian and UK elementary school students with multimedia packages developed by using Vedic Aphorisms**' has been accepted. Therefore, it can be interpreted from the above findings that development of mathematical skills of Indian and UK elementary school students with multimedia packages using Vedic Aphorisms does not differ significantly.

DISCUSSION

The multimedia packages developed by using techniques of art and Vedic aphorism have not revealed effectiveness for developing mathematical skills of elementary school students of India. According to the investigator, the reason may be that Vedic mathematics and techniques of art are new methods of learning for the students of elementary classes in India. The students are already well accustomed with the traditional methods for developing basic skills in mathematics. Learning something new needs a lot of drill work especially in the subject of mathematics. Although the students were interested in solving the problems of mathematics in their post-test after learning through multimedia, combined with vedic aphorism and techniques of art, still, watching multimedia lessons only once would not have enhanced their mathematical skills and they need more time and practice to become fully acquainted with vedic aphorisms and art techniques for the development of their skills in the subject of mathematics. Due to this reason, the effectiveness of multimedia packages is not proved to be significant in case of elementary school students of India.

The multimedia packages developed by using techniques of art have been effective in developing mathematical skills among elementary school students of UK. During the research, investigator felt that most of the students specially in UK were very much interested in learning mathematics through art. They loved to do activities using colors and were attracted towards the multimedia integrated with techniques of art for learning skills in mathematics. When these students were exposed to the multimedia lessons using art techniques, they quickly picked up and did well in their posttest of mathematical skills.

Using Vedic aphorisms in solving the mathematical problems, the researcher found that more time and practice was required in the case of students of key stage 3 in UK. Due to these reasons, the elementary school students of UK have shown significant improvement in the development of their mathematical skills with multimedia packages developed by using techniques of art, but not with multimedia packages developed by using techniques of Vedic aphorisms.

When Indian and UK elementary school students were compared for the development of mathematical skills using multimedia packages developed by using techniques of art and Vedic aphorisms, the review from researches have explored that students learn better from words and pictures as compared to words alone, because audio visual animations appear to be most effective while presenting concepts or information (Betrancourt, 2005). Putting words, written as well as spoken and pictures (static graphic images), animations and videos make the brain process more in working memory (Sweller, 2005).

The results of the studies conducted by Luzón and León (2015: 127) and Rabkin and Redmond (2006: 60) support the findings of the present study that suitable inclusion of an animation effect in the materials of teaching and learning of mathematical skills can facilitate the cognitive processes that specialize in selecting information, building representation models, and making sense, thus promoting students' learning ability, and use of arts has positive impact on the academic achievement of the students. They also suggested that those students who are struggling in this particular subject could benefit the most from art intervention. These results also support the findings of the present study that the multimedia packages developed by using techniques of art have been found to be more effective as compared to multimedia packages developed by using Vedic aphorisms for developing mathematical skills among elementary students studying in the schools of UK. The results are also supported by Tramonti (2017: 9279) that use of technology combining with art in teaching and learning of mathematics in the classrooms can provide students with digital tools which emphasize the interactivity of learning process, evaluation and construct of new knowledge by stimulating the creativity and understanding the complex relations of mathematics and reality in a better way. The content taught through multimedia helps to illustrate and explain complex concepts in the way that were previously inaccessible through the traditional teaching resources and pedagogies, hence quality of education can be improved using ICT tools. Mathematics taught by using smart class as an ICT tool enhances the retention of elementary school students in the subject of mathematics (Sharma, 2018: 108).

CONCLUSIONS

There are number of ways in which multimedia can be defined. For the present study, multimedia has been defined as the delivery of instructional content in the subject of mathematics using audio, video, pictures and animations. To achieve the objectives of present research, multimedia packages were developed with techniques of art and Vedic aphorisms to find out whether multiple modes of visual and auditory information help the students to develop their basic skills in mathematics subject. Arts have the power to explore the paths of self-knowledge and expression of self and when teachers are trained to use art in any form in their classrooms, the transformation of learning environment occurs.

The integration of art with multimedia to teach mathematics to elementary classes has proved to be effective in development of mathematical skills of UK students as revealed by the results of present study. However, in the case of Indian elementary school students, the development of mathematical skills with multimedia packages using techniques of art and Vedic aphorisms revealed contradictory results. The post-hoc analysis of the present study explored that mathematical skills of UK elementary school students significantly improved with multimedia packages developed by using techniques of art. To the best knowledge of investigator, no research study has been conducted on integration of multimedia with art and vedic aphorisms for the development of mathematical skills of elementary school students of India and UK, although few studies in context to multimedia, vedic mathematics and achievement of students in the subject and use of art to teach and learn mathematics have been quoted in this paper, yet the findings underline the need of further investigation of the subject. Pedagogical methods need to be improved in India and UK to teach the existing curriculum of mathematics using Art and vedic aphorisms so that students' skills in mathematics developed, enhances their overall achievement.

REFERENCES

Ausubel, D. P. (1990) *Education and Cognitive Processes: Psychological Guidance for the Teachers*. Edotore, Milano: FrancoAngeli.

Betrancourt, M. (2005) *The Animation and Interactivity Principles in Multimedia Learning*. New York: Cambridge University Press.

Borko, H., Jacobs, J., Eiteljorg, E., and Pittman, M. E. (2008) 'Video as a Tool for Fostering Productive Discussions in Mathematics Professional Development', *Teaching and Teacher Education*, Vol. 24, No. 2, pp. 417–436. https://doi.org/10.1016/j.tate.2006.11.012

Brophy, J. E. (2004) *Using Video in Teacher Education*. Oxford: UK: Elsevier.

Brown, M., Brown, P. and Bibby, T. (2008) 'I would rather die: Reasons given by 16 years old for not continuing their study of mathematics', *Research in Mathematics Education*, Vol. 10, No. 1, pp. 3–18. https://doi.org/10.1080/14794800801915814

Björklund, C. and Björkman, E. A. (2017) 'Approaches to teaching in thematic work: early childhood teachers' integration of mathematics and art', *International Journal of Early Years Education,* Vol. 25, No. 2, pp. 98–111. http://dx.doi.org/10.1080/09669760.2017.1287061

Cheung, A. C. K. and Slavin, R. E. (2013) 'The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis', *Educational Research Review*, Vol. 9, pp. 88–113. http://dx.doi.org/10.1016/j.edurev.2013.01.001

Clark, L. (2012) 'Maths 'too hard for students and dons': Universities drop subject from science courses', *Mail Online*. 10 February, Available at: https://www.dailymail.co.uk/news/article-2099022/Maths-hard-students-dons-Universities-drop-subject-science-courses.html.

Dani, S. G. (1993) 'Myth and reality: on 'Vedic Mathematics', *Frontline*, Vol. 10, No. 21, pp. 90–92.

Fenyvesi, K. Koskimaa, R. and Lavicza, Z. (2015) 'Experiential Education of Mathematics: Art and Games for Digital Natives', *Kasvatus ja aika,* Vol. 9, No. 1, pp. 107–134.

Flanagan, F. (2002) *An Educational Enquiry into the use of Concept Mapping and Multimedia to Enhance the Understanding of Mathematics*. Dublin City University.

Fowler, C. (1996) *Strong arts, strong schools: The promising potential and shortsighted disregard of the arts in American schooling*. Newyork: Oxford University Press.

Ghazzawi, M.T. (2002) 'Designing an Instructional Software and Studying Its Effects and the Effect of the Motion Variable on the Sixth Graders Achievement for Certain Concepts in Al -Haj, *Journal of Educational and Psychological Sciences*, Vol. 3, No. 4, pp. 14–51. http://dx.doi.org/10.12785/JEPS/030401

Harlin, R. and Brown, S. (2007) 'An arts-integrated approach for elementary level students', *Childhood Education*, Vol. 83, No. 3, pp. 172–174. https://dx.doi.org/10.1080/00094056.2007.10522905

Hillman, J. (2014) *Mathematics after 16 : the state of play, challenges and ways ahead*, Nuffield Foundation, [Online], Available: https://www.nuffieldfoundation.org/sites/default/files/files/Mathematics_after_16_v_FINAL.pdf [9 Sep 2020].

Ismail, S. A. B. S. and Sivasubramniam, P. (2010) 'Multiplication with the Vedic method', *Procedia - Social and Behavioral Sciences*, Vol. 8, pp. 129–133. http://dx.doi.org/10.1016/j.sbspro.2010.12.018

Krishna Prasad, K. (2017) 'An Empirical Study of Role of Vedic Mathematics in Improving the Speed of Basic Mathematical Operations', *International Journal of Management, IT and Engineering*, Vol. 6, No. 1, pp. 161–171.

Katgeri, A. V. (2017) 'Effectiveness of Vedic Mathematics in the Classrooms', *Scholarly Research Journal for Interdisciplinary Studies*, Vol. 4, No. 36, pp. 6765–6772. http://dx.doi.org/10.21922/srjis.v4i36.10016

Kaufmann, L. (2008) 'Neural correlates of number processing and calculation: Developmental trajectories and educational implications.', In Dowker, A. (ed.) *Mathematical difficulties: Psychology and intervention*. San Diego: CA:Academic Press, pp. 1–12.

Krug, D. H. and Cohen-Evron, N. (2000) 'Curriculum integration positions and practices in art education', *Studies in Art Education*, Vol. 41, No. 3, pp. 285–275. https://dx.doi.org/10.2307/1320380

Luzón, M. and Letón, E. (2015) 'Use of Animated Text to Improve the Learning of Basic Mathematics', *Computers & Education*, Vol. 88, pp. 119-128. https://doi.org/10.1016/j.compedu.2015.04.016

Maccini, P. and Gagnon, J. C. (2000) 'Best practices for teaching mathematics to secondary students with special needs', *Focus on Exceptional Children,* Vol. 32, No. 5, pp. 1–22. https://doi.org/10.17161/foec.v32i5.6919

Maccini, P. and Gagnon, J. C. (2006) 'Mathematics instructional practices and assessment accommodations by secondary special and general educators', *Exceptional Children*, Vol. 72, No. 2, pp. 217–234.

Malik, S. and Aggarwal, A. (2012) 'Use of Multimedia as a New Educational Technology Tool–A Study', *International Journal of Information and Education Technology*, Vol. 2, No. 5, pp. 468-471. http://dx.doi.org/10.7763/IJIET.2012.V2.181

Mayer, R.E. (2012) *Multimedia Learning*. Cambridge: 2nd edition, Cambridge University Press. https://doi.org/10.1017/CBO9780511811678

Mayer, R.E. and Johnson, C.I. (2008) 'Revising the redundancy principle in multimedia learning', *Journal of Educational Psychology*, Vol. 100, No. 2, pp. 380–386. https://doi.org/10.1037/0022-0663.100.2.380

Melnick, S. A., Witmer, J. T. and Strickland, M. J. (2011) 'Cognition and student learning through the arts', *Arts Education Policy Review*, Vol. 112, No. 3, pp. 154–162. https://doi.org/10.1080/10632913.2011.566100

Moreno, R. and Mayer, R. E. (2004) 'Personalized Messages That Promote Science Learning in Virtual Environments', *Journal of Educational Psychology,* Vol. 96, No. 1, pp. 165–173. https://doi.org/10.1037/0022-0663.96.1.165

Moreno, R. and Mayer, R. E. (2005) 'Role of Guidance, Reflection, and Interactivity in an Agent-Based Multimedia Game', *Journal of Educational Psychology,* Vol. 97, No. 1, pp. 117–128. https://doi.org/10.1037/0022-0663.97.1.117

Moreno, R. and Valdez, A. (2007) 'Immediate and delayed effects of using a classroom case exemplar in teacher education: The role of presentation format', *Journal of Educational Psychology*, Vol. 99, No. 1, pp. 194–206. https://doi.org/10.1037/0022-0663.99.1.194

Noyes, A. and Sealey, P. (2012) 'Investigating participation in Advanced level mathematics: A study of student drop-out', *Research Papers in Education*, Vol. 27, No. 1, pp. 123–138. https://doi.org/10.1080/02671520903288885

Pryor, C. R. and Bitter, G. G. (2008) 'Using multimedia to teach inservice teachers: Impacts on learning, application, and retention', *Computers in Human Behavior*, Vol. 24, No. 6, pp. 2668–2681. https://doi.org/10.1016/j.chb.2008.03.007

Rabkin, N. and Redmond, R. (2006) 'The arts make a difference', *Educational Leadership*, Vol. 63, No. 5, pp. 60–64.

Richard, D. (ed.) (2002) *Critical Links: Learning in the Arts and Student Academic and Social Development*. Washington, D.C.: Arts Education Partnership.

Seago N. (2015) 'Using Video as an Object of Inquiry for Mathematics Teaching and Learning', *Advances in Research on Teaching*, Vol. 10, pp. 259–286. http://dx.doi.org/10.1016/S1479-3687(03)10010-7

Shadish, W. R., Cook, T. D. and Campbell, D. T. (2002) *Experimental and qusi experimental designs for generalized casual inference*. Boston: Houghton-Mifflin.

Sharma, H. (2018) 'Effectiveness of educomp smart classroom teaching on retention in mathematics at elementary level', *International Journal of Multidisciplinary Research and Development*, Vol. 3, No. 6, pp. 160–164.

Slavin, R. E. and Smith, D. (2009) 'Effect of sample sizes on effect size in systemic reviews in education', *Educational Evaluation and Policy Evaluation*, Vol. 31, No. 4, pp. 500–506. http://dx.doi.org/10.3102/0162373709352369

Slavin, R. and Madden, N. A. (2011) 'Measures inherent to treatments in program effectiveness reviews', *Journal of Research on Educational Effectiveness*, Vol. 4, No. 4, pp. 370–380. https://doi.org/10.1080/19345747.2011.558986

Sweller, J. (2005) *Implications of cognitive load theory for multimedia learning.* New York: Cambridege University Press.

Tramonti, M. (2017) 'Mathematics Education reinforced through innovative learning processes', *EDULEARN17 Proceedings*, pp. 9279–9284. https://dx.doi.org/10.21125/edulearn.2017.0744

Tramonti, M. (2018) 'Technology and Art to Improve Mathematics Learning', In *Proceedings of INTED2018 Conference*. Valencia, Spain, pp. 1492–1497. http://doi.org/10.21125/inted.2018.0254

Wang, J. and Hartley, K. (2003) 'Video Technology as a Support for Teacher Education Reform', *Journal of Technology and Teacher Education*, Vol. 11, No. 1, pp. 105–138.

Review study

HIGHER EDUCATION EFFICIENCY FRONTIER ANALYSIS: A REVIEW OF VARIABLES TO CONSIDER

Gustavo Ferro[1]✉
Vanesa D'Elia[2]

[1]Universidad del CEMA (UCEMA) and CONICET, Argentina

[2]Universidad del CEMA (UCEMA), Argentina

✉ gferro05@yahoo.com.ar

ABSTRACT

The measurement of efficiency in higher education has gained a growing interest in recent years, especially due to the expansion of the university system. This paper provides a review of the literature on efficiency in higher education institutions by covering empirical articles which applied frontier efficiency measurement techniques from 1997 to 2019. We review the methodological approaches used, both parametric and non-parametric techniques, such as Data Envelopment Analysis, Malmquist index and Stochastic Frontier Analysis. Secondly, we list the applied inputs, input prices, outputs, quality, and environment variables and based on the overview, we discuss the advantages and drawbacks of the different empirical proxy variables used. We address the importance of characterizing students and research funding as raw materials of both the teaching and research services, respectively, and we provide suggestions on how to deal with them empirically. We also discuss the difference between quality and environmental variables, and we give some practical indications to distinguish them in doubtful cases.

KEYWORDS

Data Envelopment Analysis, Efficiency Frontiers Review, Stochastic Frontier Analysis, university efficiency

HOW TO CITE

Ferro G., D'Elia V. (2020) 'Higher Education Efficiency Frontier Analysis: A Review of Variables to Consider', *Journal on Efficiency and Responsibility in Education and Science*, vol. 13, no. 3, pp. 140-153. http://dx.doi.org/10.7160/eriesj.2020.130304

Article history
Received
March 3, 2020
Received in revised form
May 21, 2020
Accepted
August 10, 2020
Available on-line
September 30, 2020

Highlights

- *We explore university systems efficiency frontiers' literature to review which variables are usually considered in empirical works as well as their empirical proxy.*
- *Universities produce teaching, research, and extension (also called transfer or third mission), the latter services being difficult to parameterize.*
- *The most common variables are degrees (teaching outcomes), publications and patents (research outcomes); human and non-human resources (inputs), students and research funding (raw materials).*
- *Quality variables address controllable input and output features, while environmental variables address the context and the uncontrollable inputs.*

INTRODUCTION

The measurement of efficiency in higher education has gained growing interest in recent years, especially due to the expansion of the university system. With increasing enrolment rates all over the world, they are forced to employ increasing resources to achieve their goals. Avkiran (2001), characterize the universities productive process as one with a 'lack of profit motive[1], goal diversity…, diffuse decision making, and poorly understood production technology'. Productivity and efficiency improvements are thence not easy to define and are sometimes viewed with distrust or rejected by insiders. They are often conceived as quality-insensitive cost reductions or managerial practices which do not contribute to academic goals or that they relax academic requirements on students to improve achievement indicators (Gates and Stone, 1997).

In service sectors, productivity and efficiency are hard to measure. It is hard to identify and to measure outputs, the value added by each input, the simultaneous role of the consumer in the final outcome and as an input (e.g. personal effort devoted to study), and to account for environmental (contextual) and quality respects. Productivity measures are rank-free indicators of the rate at which inputs are transformed into outputs. Technical efficiency is defined as the ability to minimize input usage for a given output (or to maximize output for given quantities of inputs). That is not the only efficiency measure. Allocative or cost efficiency is defined as the ability to optimize the input mix, given their prices, while economic or overall efficiency considers both, technical and allocative efficiencies.

Which variables are considered in empirical studies of efficiency depends on the type of efficiency assessed: technical efficiency studies require data of physical inputs and outputs, while cost efficiency studies employ information of costs, physical outputs and input-prices. Universities have multiple objectives and outcomes, sometimes defined in a very general way. Some of them yield externalities or have public good features (that is, not rival consumption plus impossibility to exclude consumers, in issues such as social values building). Their goals and its relative importance are open to discussion. Many inputs are hard to quantify, which complicates their value-added attribution. In turn, some educational results, in words of Worthington (2001), "*defy parameterization*".

Quality definition and measuring, common in almost all service activities, add complexity to the analysis. Outcome quality correlates with the quantity and intensity of human effort invested in the processes. It is not easy, to save or replace human involvement in the productive processes or to automatize it. This fact is common in services' sectors which differ from goods' production, where productivity can be increased by replacing or automatizing human effort with machines or software. E-learning and other forms of information technology effects on university efficiency are still unknown (D'Elia and Ferro, 2019).

This paper contributes to the literature by discussing in a structured way the empirical articles on efficiency in higher education institutions which apply frontier efficiency measurement techniques. We review 89 empirical studies and almost 40 methodological and conceptual articles written in English between 1997 to 2019 on higher education efficiency frontiers. We first review the used methodological approaches, both parametric and non-parametric techniques such as Data Envelopment Analysis, Malmquist index and Stochastic Frontier Analysis. Second, we list the applied inputs, input prices, outputs, quality, and environment variables. Based on the overview, we discuss the advantages and drawbacks of the different empirical proxy variables used. Some aspects are outside the scope of this research: e-learning, economies of scale, analysis of efficiency in departments or other administrative units within universities, and another ways to address the performance of universities, such as qualitative analysis of accreditation agencies, partial productivity analysis and student's based value added. For a review of these aspects see the surveys from De Witte and López-Torres (2017), which includes all levels of education, Rhaiem (2017), which specialized in studies on research production efficiency, and Gralka (2018a) who focuses on parametric studies.

Our research question is: which variables to include in the efficiency frontier studies of universities and how to proxy them? To answer it, we provide a review of the methodological framework commonly used in empirical research of efficiency in universities. This paper is intended to be useful for researchers who are planning to conduct an efficiency analysis, e.g. for a comparison of institutions within a country or among nations, either for political planning or for providing guidelines to the heads of administration with respect to which issues should be taken into account when dealing with efficiency in universities. After this introduction, the second section briefly summarizes the methodological approaches and materials. The third section analyzes the results in, four subsections: outputs, inputs and input prices, quality, and environmental variables). The fourth section is the discussion of the review. Finally, the fifth section includes the concluding remarks.

MATERIALS AND METHODS

Methods

The empirical literature to measuring the efficiency in education has mainly used frontier methods in two forms: non-parametric (mathematical-programming) approaches and parametric (regression-based) (Furková, 2013).

The most popular non-parametric technique is Data Envelopment Analysis (DEA). It determines which decision-making units (in this case, universities) form an envelope surface of the sample they belong. The efficient decision-making units are those yielding on the frontier, while those below it, are deemed as inefficient, since with the same inputs they produce less than their "peers" in the frontier. A score is attributed to each decision-making unit, based on how much it differs from the most efficient "peers".

There are two types of envelopment surfaces: one assumes constant returns to scale or CRS (Charnes, Cooper, and Rhodes, 1978), and the other one supposes variable returns to scale or VRS (Banker, Charnes, and Cooper, 1984). Technical efficiency DEA models can be also input-oriented, output-oriented, or not-oriented. These orientations differ in terms of how is measured the distance to the frontier of each decision-making unit. As a generally deterministic method, all distance of each decision-making unit from the frontier is considered inefficiency; the method does not distinguish randomness, nor external noise affecting scores. In their standard variants, it is vulnerable to outliers and measurement errors.

There are different DEA models' extensions, including two-stage DEA, bootstrapping, and distance-function analysis (Daraio, Bonaccorsi and Simar, 2015). Besides, when efficiency is studied in different periods, productivity change of each decision-making unit can be decomposed as catching-up to the frontier, and frontier shifting-up. The Malmquist index separates both effects. Malmquist assumes CRS, which can be a restrictive assumption of the underlying technology. Another popular method is Hicks-Moorsteen Total Factor Productivity (TFP) index, which is calculated as the quotient between Malmquist output and input quantity indexes (Russell, 2018).

A DEA model evaluates the efficiency performance of n decision-making units (universities), each one producing s outputs with m inputs. For each university, DEA solves an optimization problem seeking the optimal weights for the inputs, and for the outputs, which maximize the ratio among the weighted sum of output divided on the weighted sum of inputs.

1 We do not consider for-profit universities although they do exist in some contexts. See Sav (2012g).

DEA provides a scalar measure of the efficiency of a collection of decision-making units with a common set of multiple inputs and outputs, jointly with objectively determined weights for outputs and inputs (Charnes, Cooper, and Rhodes, 1978: 429). DEA objective is to measure the efficiency of resource utilization in every possible combinations, present in different organizations and technologies in use, to yield a measure to evaluate accomplishments, or resource conservation possibilities, for every decision-making unit with the resources assigned to it (Charnes, Cooper, and Rhodes, 1978: 443).

DEA '…employs mathematical programming to obtain ex post facto evaluations of the relative efficiency of management accomplishments, however they may have been planned or executed…' (Banker, Charnes, and Cooper, 1984: 1078). Lacking engineering characterization of the underlying technology, which is a frequent problem in empirical economics, DEA method determines "relative efficiency" of each decision-making unit, by reference to "rankings" of the observed results (Charnes, Cooper, and Rhodes, 1978: 430).

The efficiency measure (score) for any decision-making unit is obtained as the maximum ratio of weighted outputs to weighted inputs, subject to similar ratios for every decision-making unit being less or equal to unity. Following the Charnes, Cooper, and Rhodes (1978) notation, for n decision-making units ($j = 1,\ldots, n$), s outputs and m inputs the problem is:

$$\text{Max}\,\theta = \frac{\sum_{r=1}^{s} u_r\, y_{r0}}{\sum_{i=1}^{m} v_i\, x_{i0}} \qquad (1)$$

Subject to:

$$\frac{\sum_{r=1}^{s} u_r\, y_{rj}}{\sum_{i=1}^{m} v_i\, x_{ij}} \le 1;\ j = 1,\ldots,n$$

$$u_r, v_i \ge eps; \text{where } eps \text{ is an infinitesimal constant}$$

$$r = 1,\ldots,s;$$

$$i = 1,\ldots,m$$

where $\boldsymbol{\theta}$ is the maximum ratio for decision-making unit 0, y_r are the outputs (for $r = 1,\ldots, s$), x_i are the inputs (for $i = 1,\ldots, m$), outputs and inputs being positive. The u_r, v_i are the weights yielded by the solution of the problem, by the data on all decision-making units which are being used as a reference set[2]. The efficiency of one decision-making unit of the sample is to be rated relative to the others, distinguishing it by "0" in the functional (but preserving its original subscript in the constraints). This decision-making unit has the most favorable weighting allowed by the constraints (Charnes, Cooper, and Rhodes, 1978: 430). An optimal $\boldsymbol{\theta^* = \max \theta}$ will always satisfy $0 \le \theta^* \le 1$ with optimal solution values u_r^*, $v_i^* > 0$ (Banker, Charnes, and Cooper, 1984).

The "fractional program" presented in formula (1) can be converted to a "linear program", as in formula (2):

$$\text{Max}\,\theta = \sum_{r=1}^{s} u_r\, y_{r0} \qquad (2)$$

Subject to:

$$\sum_{i=1}^{m} v_i x_{i0} = 1$$

$$\sum_{r=1}^{s} u_r\, y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0;\ j = 1,\ldots,n$$

$$u_r, v_i \ge eps; \text{where } eps \text{ is an infinitesimal constant;}$$

$$r = 1,\ldots,s;$$

$$i = 1,\ldots,m$$

Efficiency is defined as the quotient $E_r = y_r/Y_r$, where y_r is the actual output r produced by the decision-making unit under analysis, and Y_r is the maximum feasible output obtained by the same input set, where $0 \le E_r \le 1$ (the score is thence relative to some maximum possibility). The weights are objectively determined to obtain a dimensionless E_r scalar measure of efficiency from observational data, subject only to the constraints established in (1). Therefore, no other set of common weights will give a more favorable rating relative to the reference set (Charnes, Cooper, and Rhodes, 1978: 431).

Model (1) can be converted into a linear program in two ways: input-oriented, and output-oriented versions. Here we are presenting the first version. In the same, the linear programming model is configured to determine how much could the input contract if used efficiently in achieving the same output level. In the output-oriented version (which formula we omit for brevity) the model seeks to determine how much could the output expand is same inputs' quantities are used efficiently.

In the so-called CCR Model (named after the initials of the authors: "Charnes–Cooper–Rhodes" of Charnes, Cooper, and Rhodes, 1978), the set of efficient decision-making units form an envelope relative to observational data from all $j = 1,\ldots, n$ decision-making units. Productivity and technical efficiency are equivalent only when the technology exhibits constant returns to scale (CRS), and the Model produces an "overall efficiency" rating. The BCC Model 'extrapolate the performance of the most efficient DMUs [for decision-making unit] with efficient scale sizes (for their given input and output mixes) and identify any scale inefficiencies that may be reflected in the level of operations of other DMUs', leading to a "pure technical efficiency" rating (Banker, Charnes, and Cooper, 1984: 1084), where the acronym BCC refers to the initials of the authors of this contribution, "Banker–Charnes–Cooper"). The BCC Model applies to technologies with variable returns to scale (VRS), which permits to compare the maximum average productivity attained at the most productive scale size with the average productivity at the actual scale of production to measure scale efficiency (Ray, 2004).

Under VRS, it is possible to separate pure technical inefficiency from scale inefficiency. In this case, only decision-making units of similar scale are compared. Units deemed as inefficient under CRS assumption can be efficient once VRS is allowed[3].

2 Because individual inputs and outputs need to be suitably and meaningfully aggregated, in the absence of market prices, which are the natural weights, DEA endogenously generates "shadow prices" of inputs and outputs for aggregation. Thence, the estimated weights can be understood as "shadow prices" (Ray, 2004).

3 For brevity we omit the input-oriented formulas since the underlying reasoning was explained above. In the same vein, in the case of panel data, repeated observations of the same unit j over several periods the variables also should include the change over time t.

The regression-based approach estimates the parameters of a specific functional form for the production or cost frontier. The most popular approach is Stochastic Frontier Analysis (SFA), due to the seminar papers of Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). The SFA models can be estimated with many different functional forms and error specifications, and with different types of quantitative data.[4] This technique decomposes the traditional random regression error term into two components: a normally distributed pure randomness term v (with zero mean and positive variance), and an inefficiency term u, (that assumes different statistical distributions).[5] For cross-sectional data, the production function can be represented as:[6]

$$Y_j = X_j\,\beta + \left(v_j - u_j\right) \qquad (3)$$

where for each decision-making unit j, Y_j is the vector of actual output, X_j is the vector of inputs, β is a vector of estimated coefficients, $u_j \ge 0$ is the production inefficiency and v_j is a random error.

In the case of panel data, repeated observations of the same unit j over several periods allow an estimation of unobserved producer-specific effects, that may affect efficiency but are not controlled by the producer. The general specification for production function can be written as:

$$Y_{jt} = X_j t\,\beta + \left(v_{jt} - u_{jt}\right) \qquad (4)$$

The variables are the same as in Equation (3) but they also include the change over time t.

Unit-specific technical inefficiency can vary systematically, or it can be constant across time. Time-varying inefficiency models comprehends Cornwell, Schmidt, and Sickles (1990) and Lee and Schmidt (1993) models, Kumbhakar (1990) and the time-decay and the inefficiency-effects model of Battese and Coelli (1988, 1992).[7] Time-invariant inefficiency models are the random-effects model of Pitt and Lee (1981) and the fixed-effects version of the Schmidt and Sickles (1984) model.[8] These models ignore the possibility that is time-invariant heterogeneity may also be considered as inefficiency (Greene, 2005a). If this is the case, fixed and random SFA effects models may produce biased inefficiency estimates.

To address these shortcomings, Greene (2005b) proposed two models: the "true fixed effects" (TFE) and the "true random effects" (TRE) that allow to separate time-varying inefficiency from unit specific time-invariant unobserved heterogeneity.

To deal with observed heterogeneity, the most common approach is to parameterize the mean or the mode of the pre-truncated inefficiency distribution (Greene, 2008). Alternatively, the distribution of inefficiency can be rescaled, parametrizing the variance of the pre-truncated inefficiency distribution (Caudill and Ford, 1993; Caudill, Ford, and Gropper, 1995; and Hadri, 1999). Recent methodologies allow also separating transient from persistent or long-term inefficiency (Badunenko and Kumbhakar, 2016; Kumbhakar, Lien, and Hardaker, 2014; Tsionas and Khumbhakar, 2014; Filippini and Greene, 2016; Kumbhakar and Heshmati, 1995).

Empirical results are not directly comparable, since they depend on the sample and on the method used. Nevertheless, Bauer et al. (1998) suggested a protocol to follow when the estimates to be compared are the result of different techniques. Their point is straightforward: results may not be equal, although they should be consistent. They propose six consistency conditions: (1) similar efficiency distributions, (2) similar ranking of the decision-making units, (3) the most efficient and most inefficient decision-making unit should be same among the rankings, (4) reasonable stability of efficiency along the time, (5) consistency with other performance measures (such as partial productivity or average costs), and (6) congruency with the real conditions of the activity under analysis. Of the former, conditions (1) to (3) are about internal (methodological) consistency, while conditions (4) to (6) concern about external (empirical) consistency.

Materials

Table 1 groups the examined studies by methodological approaches: parametric and non-parametric, production and cost, cross sectional database and panel, etcetera. Of those articles which run quantitative estimates of efficiency 54 percent run non-parametric estimates, most being production frontiers, SFA comprehends 40 percent of the cases, mostly cost frontiers, and 6 percent uses both methods. Heterogeneity aspects, as well as the distinction between transient and permanent inefficiency, are present in the most recent SFA estimates. In our literature analysis, we examine 11 conceptual discussions on university efficiency frontiers, 5 surveys and 30 methodological studies.

We reviewed studies from the following countries: 10 for the United Kingdom (UK), 15 for the United States (USA),

4 The Cobb-Douglas production function is frequently chosen, because of its simplicity of estimation and interpretation. Another functional form commonly used is the Trans-Logarithmic because of its flexibility to accommodate quadratic and interaction terms between independent variables (Laureti, Secondi and Biggeri, 2014).

5 It is assumed that the distribution of the technical inefficiency (u_i) is usually half normal, truncated normal, exponential, or normal gamma.

6 In the case of the cost function, Y_i is the vector of costs and the compounded error term defined as (v_i+u_i).

7 "Time varying decay" or TVD model is developed in Battese and Coelli (1988), and "Time invariant" or TI model, is presented in Battese and Coelli (1992).

8 The mentioned u_i can be constant across time in each decision unit i considered (that is $u_i = u$). This assumption is made in a set of models with time-invariant efficiency: firstly in Pitt and Lee (1981), where u_i is assumed a half-normal distribution with constant variance; secondly in Schmidt and Sickles (1984), in which the constant of the regression can be fixed or random; in the fixed-effect case, the unmeasured invariant component of inefficiency heterogeneity is included in the estimates' constants; and thirdly in Battese and Coelli (1988), where u_i has a truncated-normal distribution with different than zero mean and constant variance. Instead, if u_i varies across time t in each decision-making unit i ($u = u_{it}$), the model is a Time Varying Decay one. These include firstly, Kumbhakar (1990) in which $u_{it} = u_i\,[1+exp(bt+ct^2)] - 1$. It is a flexible formulation where none probability distribution is attributed ex ante; secondly, Battese and Coelli (1992), where $u_{it} = u_i\,exp[-\eta(t-T_i)]$; u_i is assumed follows a truncated-normal, with mean different than zero and constant variance, while η explains the time pattern of inefficiency; and thirdly, Battese and Coelli (1995), where u_{it} follows a truncated-normal in zero.

14 for Italy, 6 for Australia, 4 for Germany, 5 for Spain, 1 for Greece, 1 for Turkey, 3 for Brazil, 1 for the Philippines, 2 for New Zealand, 2 for India, 1, for Argentina, 1 for Bangladesh, 1 for China, 2 for the Czech Republic, 2 for Poland, 10 study two countries and 6 for transboundary studies on European Countries. With respect to the level of analysis, 76 articles study teaching, and 9 study research, none studies extension activities.

Non-Parametric Estimates (* Two Stages DEA)	
Production, Cross-Sectional (10 papers)	Abbott and Doucouliagos (2003), Agasisti and Pérez-Esparrells (2010), Agasisti et al. (2012), Avkiran (2001), Costa, Ramos and de Souza (2011), Katharaki and Katharakis (2010), Johnes (2006a, 2006b), Kuah and Wong (2011), Marinho, Resende and Façanha (1997), Athanassopoulos and Shale (1997).
Production, Panel (23 papers)	Abbott and Doucouliagos (2003), Abramo and D'Angelo (2009), Agasisti (2011, 2014) *, Agasisti and Bonomi (2014), Agasisti and Dal Bianco (2006), Agasisti and Johnes (2009), Agasisti and Wolszczak-Derlacz (2016), Andersson et al. (2016), Barra and Zotti (2016b), Berbegal-Mirabent, Lafuente, and Solé (2013), Berbegal-Mirabent (2018), Cantele, Guerrini and Campedelli. (2016), Castano and Cabanda (2007), Costa, Ramos, and de Souza (2011), D'Elia and Ferro (2020), Flegg and Allen (2007), Flegg et al. (2004), Guccio, Martorana and Monaco (2016), Johnes and Yu (2008), Jones and Johnes (1993), Lee and Worthington (2016), Mikušová (2017), Selim and Bursalioglu (2013).
Cost, Cross-Sectional (1 paper)	Johnes and Tone (2016).
Cost, Panel (3 papers)	Abramo and D'Angelo (2009), Agasisti (2011), Johnes and Johnes (2009).
Malmquist, Panel (6 papers)	Agasisti and Pérez-Esparrels (2010), Das and Das (2014), Flegg et al. (2004), Johnes (2008), Wolszczak-Derlacz (2017), Worthington and Lee (2008).
Distance Function, Panel (3 papers)	Abbott and Doucouliagos (2009), Barra and Zotti (2016a, 2016b), Daraio, Bonaccorsi and Simar (2015).
Parametric Approach Estimates (# address unobserved heterogeneity SFA, & address transient and permanent inefficiency SFA)	
Production, Cross-Sectional (1 paper)	Agasisti and Johnes (2010).
Production, Panel (7 papers)	Agasisti and Gralka (2017), Agasisti, Barra and Zotti (2016), Erkoc (2015), Guccio, Martorana and Monaco (2016), Laureti, Secondi and Biggeri (2014), Sav (2012h), Zoghbi, Rocha and Mattos (2013).
Cost, Cross-Sectional (1 paper)	Izadi et al. (2002).
Cost, Panel (25 papers)	Agasisti (2016), Agasisti and Gralka (2017), Agasisti and Johnes (2010, 2013), Agasisti and Salerno (2007), Gralka (2018b), Horne and Hu (2008), Johnes and Johnes (2009), Johnes, Johnes and Thanassoulis (2008), Johnes and Salas-Velasco (2007), Johnes and Schwarzenberger (2011), Mamun (2011), Robst (2001), Sav (2011, 2012b, 2012c, 2012d, 2012e, 2012f, 2012g, 2012i, 2012j, 2012k, 2012l, 2016), Titus, Vamosiu and McClure (2016).
Both Parametric and Non-Parametric Estimates	
Cost, Panel (5 papers)	Agasisti and Haelermans (2016), Barra and Zotti (2016), Barra, Lagravinese and Zotti (2018), Kempkes and Pohl (2010), Sav (2012a).
Conceptual and Surveys	
Surveys (5 papers)	De Witte and López-Torres (2017), Gralka (2018a), Rhaiem (2017), Johnes (2004), Worthington (2001),
Conceptual (11 papers)	Agasisti (2017), Bauer et al. (1998), De Fraja and Valbonesi (2012), Dyson et al. (2001), Eagan and Titus (2016), Gates and Stone (1997), Mensah and Werner (2003), Millot (2015), Salerno (2003), Warning (2004), Wolff, Baumol and Saini (2014).

Table 1: Summary of the methods applied for estimating efficiency

RESULTS

In this Section we review the main variables used to assess efficiency in education through the frontier methods discussed in previous Section. We first analyze the output variables considered in the different articles. We then make an overview of the input variables, quality and the contextual (environmental variables).

Outputs

University outputs can be classified in teaching (knowledge dissemination), research (basic or applied knowledge production), and extension (also known as transfer, public, community or "third mission") activities (See Table 2). The latter comprehends services which possess external effects and public goods aimed to varied audiences beyond campuses (Johnes and Johnes, 2009). There are complex substitution or complementarity interactions between teaching and research. On the one hand, there are potential scope economies among teaching and research; on the other hand, both consume resources and their rewards differ in the short- and long-run. Omitting research activities, implicitly, is such assuming no complementarities or substitutions exist among teaching and research (Horne and Hu, 2008).

Teaching output is proxied as the number of degrees completed, sometimes distinguishing between undergraduates and graduates, results in standardized tests, head-count of enrolled students standardized by full-time equivalent, courses/hours/credits taught to proxy the added knowledge, job or remuneration attainments by degreed to address students' potential of employment, earnings, or rate-of-return, and/or graduate students admitted.

Research output is commonly proxied by published documents. They are measured by some weighted sum of articles, books or chapters, conference papers, etcetera, where the problem is how to weight the different impact factor and age of the academic products, because practices and traditions differ among disciplines. It is also complex to compute externalities from co-authorship. Other measures for research outputs include citation indexes, which measure the impact of the published research outcomes, head-count of approved dissertations, patents and other intellectual property rights, measured by the number of registers, attached with some criteria to weigh them, awards, with similar problems than the former, grants, project money and/or partnership with business.

Various facts add complexity to measure research output: (1) Some research outcomes are not ex-ante observable or ex-post measurable (D'Elia and Ferro, 2019); (2) Unobserved research effort may well lead to no results, and conversely, given that "*serendipity and luck may yield huge returns at little cost*" (De Fraja and Valbonesi, 2012); (3) The research prestige of a whole university can be originated in a small group of researchers within that university; (4) Also, the account of outcomes may be based on historical achievements, not reflecting contemporaneous intellectual production (Johnes and Yu, 2008).

Extension activities consist in generating public goods or external effects. On the one hand, they can yield good reputation for the university, leveraging fundraising or enrolment, although the connections are hard to establish. On the other hand, and because these activities include citizenship development (attitudes and values), they are in general hard to quantify. The extension services can include also cultural, sport and recreational events that can be difficult to value and to weigh, opinion or advice in community or societal issues, again difficult to measure and weigh, and non-formal education for out-of-campus groups, disadvantaged or not. The empirical analysis omits extension activities because of difficulty in quantifying their outcomes meaningfully, since externalities, not only in education, are challenging to measure (Salerno, 2003).

Inputs and input prices

The inputs can be classified in human and non-human resources (See Table 2). The former includes teaching and research effort of the university labor force and "raw materials", measured through full-time equivalent students to be taught, and the latter are physical and financial resources.

Human resources are measured by the academic and non-academic staff as headcount or salaries paid to different categories of personnel. Faculty headcount, with some weights attached, such as one for full professors, a different one for associates and the third one for assistants, is the most frequently considered input variable. Because some academics work in both teaching and research activities, the ratio of researchers or research workload over full-time academics can be calculated to attribute inputs to outputs.

Non-human resources include facilities and materials, which can be measured in physical or financial units, such as surface of laboratories or classrooms, classroom seats, computers, books in libraries, etcetera, in the former, and hardware money expenditure in the latter.

When costs frontiers are estimated, the unit prices of inputs result from some quotient between expenditure items and physical units employed: average labor cost of full-time academics of certain level, or an average cost for square meter of classroom, for instance.

Quality

Quality variables are present in less than 20 percent of the examined studies (see Table 2). Quality can and ideally should be assessed either in outputs or inputs, for fair and meaningful comparisons, through different coefficients or dummy variables. To address teaching activities quality, researchers use indexes of completion, achievements and recognition, given length, structure and contents of the programs, time dedication, and qualification of the staff, while in research, quality is related to value and impact. If these elements are ignored, results can be incomplete and probably biased. Quality is costly, and it is in the hands of the universities to allocate resources for its improvement.

They can include drop-out rates as a proportion of the cohort, the faculty per student ratio, the staff expenditure on total expenditure ratio, the professorship or tenured academics ratio, the full-time researchers, teaching and/or management workload on total faculty. Impact factors and citation indexes account for quality in research.

In empirical studies, expected signs of quality variables are negative in productive efficiency estimates since they consume inputs, and positive in cost estimates since they are costly. Nevertheless, more complex relationships can appear in the empirical work, since quality yields prestige which attracts talented professors and students, provided the system under analysis has a reasonable degree of mobility between universities.

Environmental variables

Environmental variables are included in more than 70 percent of the analyzed studies (See Table 2). Those allow addressing for observable heterogeneity due to uncontrollable factors. The main difference between environmental and production or cost drivers is that the former influence technology structure, while the latter influence the efficiency with which the drivers are converted in outputs (costs)[9].

It can be distinguished three groups of environmental variables: students' intellectual, economic and social background (ethnic, age and gender characteristics of students); region where the university is situated (poor or rich); and type of university (big or small, old or new, private or public, for-profit or non-for profit, laic or religious, specialized or generalist, those teaching labor-intensive disciplines such as social sciences or humanities or capital-intensive disciplines, such as medical schools).

With respect to students' background, the contextual variables include their intellectual background, measured through high school grades or results in selection exams, household socioeconomic conditions, proxied through the family income with respect to per capita GDP, parental qualification, measured by years of parents' schooling or degrees attained, full-time students on total students, gender and ethnic composition, foreign or out of the region students' proportion, and age of students.

Related with the university region, some studies use the regional GDP with respect to national average, and some indication of the regional human capital, such as years of average education with respect to national average.

Addressing the university type, studies include: size; ownership and governance, contemplating public or private ownership; non-for-profit or for-profit when this option exists, or laic or religious, degree of specialization in capital intensive disciplines to denote the different hardware intensity, typically considering the share of natural sciences, engineering and/or medicine on total, and the age, whether it is old or new with respect to a local system, in the understanding that history could matter in efficiency.

DISCUSSION

Universities produce teaching, research, and extension services. The latter are the most elusive, since they adopt mostly the form of external effects, difficult to parameterize. We did not find any empirical study including transfer activities in efficiency frontier studies.

Teaching and research services, while simpler to proxy empirically than third mission services, are not always addressed jointly. A priori, it is unknown if economies or diseconomies of scope predominates, nor its intensity. If only teaching or research are included, the implicit assumption is that no scope economies or diseconomies exist. Most of non-parametric studies are intended to address technical efficiency, and in that context, it is easy to consider the multi-output perspective. While in DEA it is possible to consider multiple outputs, it is not possible to do the same in SFA production frontiers (save, when "output" is a composite or a bundle of products or services), while it is possible to consider multiple outputs in a cost frontier SFA estimate.

The graduate head count is the more common output of the teaching service activity. It may underestimate outcomes, because of drop-outs consideration, that is students which consumed resources without achieving a certificate. It is important to consider whether using models with ratio variables or absolute variables because the methods for measuring efficiency are fundamentally different for such models. The same consideration is relevant with other input/output ratios. Results in standardized tests as an alternative measure of output is only possible if that kind of exams are practiced. It is worth recalling that student´s grades depend partially on the student´s capabilities, the university marking practices, and the quality of teaching and supervision given to students. Even when the number of students is a possible measure for teaching output, they are in fact the "raw material" of the process, that is, should be considered as an input (Salerno, 2003; Cantele, Guerrini and Campedelli, 2016). This fact is not always addressed and is one of the lessons of this study. Below, we propose a criterion to deal practically with the issue.

Studies concentrated on research are less frequent, and the output is measured by two different ways: through bibliometric indicators of publications and / or counting patents and other intellectual property rights. Sometimes research funding is used as a proxy for research output. In fact, it is an input, since it does not guarantee some results will be achieved or even whether that money would be spent in the final output (Johnes and Yu, 2008). This fact is not always addressed in the same sense, and students are sometimes not considered as inputs, instead, they are treated as outputs. Again, we propose below a criterion to deal with this fact in empirical work.

The second category of variables are those referred to inputs. As in the textbook production function where the output depends on labor and capital, in the context of universities these can be human and non-human resources (academic and non-academic personnel and facilities), plus the "raw material" of the process, students (for teaching services) and project or grant money (for research). Nonetheless, as stated, sometimes students and research money are considered as outputs.

We propose as a possible solution to this ambiguity the following procedure: in DEA studies, correlating students with the output measure and research funding with the research measure. If correlations are positive, they are inputs; in SFA studies, analyzing the sign of the partial derivative of the estimated frontier with respect to students (research money): in a production function, the expected sign for inputs is positive.

Human resources are usually proxied by head count or by money spent in salaries; non-human resources can be proxy by different physical measures of facilities or financial resources spent on them.

The determination of meaningful input prices is also an issue when parametric cost functions are estimated. Typically, they are computed as a ratio between expenditure and some physical input measure.

Quality variables try to address observable characteristics of inputs and outputs under control of the universities (present in 20 percent of the examined studies). Its omission can convey to biased results or misinterpretation of the results.

Environmental variables encompass the differences in the context, out of the university control (empirically included in 70 percent of the analyzed studies). Students' socio-economic background is highly correlated with future performance of graduates thus it is a characteristic to be considered when data is available. At the same time, universities in some cases deliberately can select their students by socio-economic condition.

Expected signs in inputs are positive in production estimates, input prices are positively related to costs in cost estimates, quality increasing aspects are positive in cost estimates (quality is costly) and negative in production estimates (quality improvements consume resources), while in environmental variables signs will depend on more case-specific aspects.

For instance, consider the following possible environmental variables: old versus new universities, public versus private, socially diverse versus elitists one, specialized in arts, humanities, or social science, versus specialized in science. Old universities can be more attached to traditions than modern ones and being less prone to technical change; public universities can be very efficient in some environments, while not in others; ethnic diversity can yield a very rich environment of motivation or can be a load on efficiency if disadvantaged minorities need more than the average resources for reaching same attainments. Nonetheless, it is unambiguously more expensive a medicine or engineering school than a social science's one, because of the different intensity of facilities needed.

The issue of distinguishing among quality and environment is easily solved in certain cases, while in others some ambiguity could appear. The delimitation criteria in our understanding is that "quality" is under control of the decision-making units: the unit is spending resources in some respect deliberately, while "environment" is not under control.

CONCLUSIONS

We explore the worldwide literature of efficiency frontiers in university systems by analyzing 89 specific studies published from 1997 to 2019. Most of the papers we review use non-parametric DEA models to estimate efficiency (54 percent), followed by SFA models (40 percent), and both methods (6 percent). Besides, we analyze 46 conceptual and methodological studies.

Specifically, we are concerned with which variables to include in the efficiency frontier studies, why to consider, and how to proxy them. A fundamental part of the estimates is choosing appropriate variables to represent the production or cost process, and good proxies to measure them. In higher education, there is no consensus on which variables to include for outputs, inputs, input prices, quality, and environment, and even to model the production process and the cost structure. We concentrate in non-for profit universities and university systems as a whole and do not consider economies of scale and scope studies in universities, and on departments' or other administrative units to study efficiency within one university, as for example in Flégl and Vltavská (2013) or in Martín (2016).

Graduates, publications, and patents are the most common outputs for teaching and research activities, respectively. Being the inputs human and non-human resources and stating students and research funding as the raw materials of the teaching and research processes, respectively. Quality variables address controllable input and output features, while environmental variables address the contextual and uncontrollable differences. Of the discussion in the literature, we can conclude the importance of characterizing students and research financing as raw materials of the teaching and research services, respectively, and we provide suggestions on how to deal with them empirically. Also, we clarify some discussion on the distinction between quality and environmental variables.

In the near future it is expected more research on the role of heterogeneity of universities, more effort in addressing quality issues, without which some essential details can be lost, attempt to develop environmental variables to better capturing diversity, and more studies on the higher education segments not constituted by universities. Another important aspect is endogeneity and self-selection of good/wealthy students in good/wealthy universities. Universities can be chosen for a by-product as crucial as educational service itself, such as networking.

In services' sectors, the productive process and the cost attribution are more elusive than in goods' sectors. The complexity and subtlety of the processes demand great care in the definition and measurement of the variables. Our discussion, on the one hand, could help scholars trying to design empirical studies on university efficiency, and on the other hand could help policy makers to avoid unreflective cost or quality cuts based on partial productivity or average cost measures.

9 The literature discusses how to include environmental variables in efficiency estimates. In the past, a two-stage approach for including environmental variables was common, both in parametric and non-parametric approaches, however it was criticized by its limitations (Coelli et al., 2005; Simar and Wilson, 2007). In the first stage efficiency scores are estimated (without including environmental variables), and in the second stage the scores are regressed against explanatory variables. This procedure has two important econometric problems. Firstly, it assumes in the first stage that the efficiency terms are identically distributed in the estimation of the frontier model, while in the second stage the regression implicitly assumes that the scores are not identically distributed. Secondly, the explanatory (environmental) variables of the second stage must be assumed to be uncorrelated with the explanatory variables of the first stage. Otherwise, explanatory variables are omitted in the first stage, and thus the second stage estimates are biased. For these reasons, Battese and Coelli (1995) recommends a "one-stage" procedure, which solves these econometric problems, including the environmental variables in the single estimate of the efficiency frontier model.

Output variables	Empirical proxy	Authors
Degrees completed	Head count	D'Elia and Ferro (2020), Cantele, Guerrini, and Campedelli (2016), Laureti, Secondi and Biggeri (2014), Kuah and Wong (2011), Katharaki and Katharakis (2010), Johnes (2006 a), Salerno (2003), Avkiran (2001)
Results in standardized tests	Standardized tests grades	Laureti, Secondi and Biggeri (2014), Zoghbi, Rocha and Mattos (2013), Kuah and Wong (2011), Johnes (2006b), Worthington (2001)
Enrolled students	Head count	Cantele, Guerrini and Campedelli (2016), Salerno (2003)
Knowledge added	Hours, courses, or credit taught	Kuah and Wong (2011), Cohn and Cooper (2004)
Student potential employment	Job attainment once graduated	Zoghbi, Rocha and Mattos (2013), Kuah and Wong (2011), Worthington (2001)
Students' potential earnings	Salaries once graduated	Zoghbi, Rocha and Mattos (2013), Johnes and Johnes (2009), Worthington (2001)
Admission to graduate studies	Head count	Ferreyra et al. (2017)
Published products	Weighted sum of articles, books, conference papers, etc	Cantele, Guerrini and Campedelli (2016), Kuah and Wong (2011), Worthington and Lee (2008), Salerno (2003)
Cited publications	Count of citations	Kao and Hung (2008), Avkiran (2001)
Ph.D. awarded	Head count	De Fraja and Valbonesi (2012), Kuah and Wong (2011), Worthington and Lee (2008)
Patents and other intellectual property rights	Number of registers	Kao and Hung (2008), Kuah and Wong (2011)
Grant, project, business contract or research money	Money spent	Kao and Hung (2008), Kuah and Wong (2011), Salerno (2003), Katharaki and Katharakis (2010), Cantele, Guerrini and Campedelli (2016)
Citizenship, behavioral changes, value transmission	None, hard to measure meaningfully	Ferreyra et al. (2017), Avkiran (2001)
Cultural, sport or recreational events	None, hard to measure meaningfully	Cohn and Cooper (2004), Avkiran (2001)
Informed opinion in media or community events	None, hard to measure meaningfully	Cohn and Cooper (2004), Avkiran (2001)
Input variables	**Empirical proxy**	**Authors**
Academic Staff	Full-time Equivalent Academic Head Count	D'Elia and Ferro (2020), Laureti, Secondi and Biggeri (2014), Kuah and Wong (2011), Johnes and Yu (2008), Worthington and Lee (2008), Avkiran (2001)
Students to be taught	Head count	D'Elia and Ferro (2020), Laureti, Secondi and Biggeri (2014)
Non-academic staff	Head count	Worthington and Lee (2008), Avkiran (2001), Worthington (2001)
Non-human resources	Classroom and labs surface, seats, computers, library items, materials	Cantele, Guerrini and Campedelli (2016), Laureti, Secondi and Biggeri (2014)
Non-human inputs expenditure	Money spent	Kao and Hung (2008), Worthington and Lee (2008), Worthington (2001)
Quality variables	**Empirical proxy**	**Authors who proposed or discussed them**
Drop-out rates	Proportion on cohort	Zoghbi, Rocha and Mattos (2013)
Student on Faculty	Proportion on Faculty	Ferreyra et al. (2017)
Staff expenditure	Proportion on total expenditures	Ferreyra et al. (2017)
Professorship or Tenured Academics	Proportion on Academics	Sav (2012a), Johnes and Yu (2008), Kuo and Ho (2008)
Index of Full-Time Faculty	Full-time Faculty on Total Faculty	Sav (2012a)
On-Line Students	On-line on total students	Wolff, Baumol and Saini (2014)
Research or Doctoral Students	Ratio on total academics	Kao and Hung (2008), Johnes and Yu (2008)

Environmental variables	Empirical proxy	Authors who proposed or discussed them
Students intellectual background or potential	High school grades, access exams grades	Ferreyra et al. (2017), Laureti, Secondi and Biggeri (2014)
Individual effort and peer externalities	None, hard to measure meaningfully	Worthington (2001)
Parental economic condition	Parents' per capita GDP	Laureti, Secondi and Biggeri (2014)
Parental education level	Parents' years of schooling	Zoghbi, Rocha and Mattos (2013)
Full-time students	Full time on total students	Zoghbi, Rocha and Mattos (2013)
Gender / age composition of students	Female on total students, average age of students	Laureti, Secondi and Biggeri (2014), Zoghbi, Rocha and Mattos (2013), Johnes (2006b)
Ethnic composition of students	Minority on total students	Worthington (2001)
International students	Foreign to domestic students	Laureti, Secondi and Biggeri (2014)
Regional GDP	GDP of the region over national average	Cantele, Guerrini and Campedelli (2016), Zoghbi, Rocha and Mattos (2013), Laureti, Secondi and Biggeri (2014), Costa, Ramos and de Souza (2011), Agasisti and Johnes (2009)
Regional human capital	Average years of schooling in the region on national average	Cantele, Guerrini and Campedelli (2016), Zoghbi, Rocha and Mattos (013)
Size of the university	With respect to local context	Cantele, Guerrini and Campedelli (2016), Daraio, Bonaccorsi and Simar (2015)
Ownership or Governance	Public or private, For-profit, or non-for-profit, laic or religious	Millot (2015), Laureti, Secondi and Biggeri (2014)
Facilities intensiveness	Share of medicine, engineering and or science on total disciplines	Cantele, Guerrini and Campedelli (2016), Daraio, Bonaccorsi and Simar (2015), Laureti, Secondi and Biggeri (2014), Johnes (2004), Johnes and Johnes (2009, 1993), Horne and Hu (2008), Cohn and Cooper (2004)
Age of the university	Old or new in local context	Johnes and Johnes (2009, 1993)

Table 2: Summarizing variables used in higher education efficiency frontier studies

REFERENCES

Abbott, M., and Doucouliagos, C. (2009) 'Competition and Efficiency: Overseas Students and Technical Efficiency in Australian and New Zealand Universities', *Education Economics*, Vol. 17, No. 1, pp. 31–57. https://doi.org/10.1080/09645290701773433

Abbott, M. and Doucouliagos, C. (2003) 'The Efficiency of Australian Universities: A Data Envelopment Analysis', *Economics of Education Review*, Vol. 22, No. 1, pp. 89-97. https://doi.org/10.1016/S0272-7757(01)00068-1

Abramo, G. and D'Angelo, C.A. (2009) 'Assessing technical and cost efficiency of research activities: A case study of the Italian university system', *Research Evaluation*, Vol. 18, No. 1, pp. 61–70. https://doi.org/10.3152/095820209X408869

Agasisti, T. (2011) 'Performance and Spending Efficiency in Higher Education: A European Comparison Through Non-Parametric Approaches', *Education Economics*, Vol. 19, No. 2, pp. 199-224. https://doi.org/10.1080/09645290903094174

Agasisti, T. (2014) 'The Efficiency of Public Spending on Education: An Empirical Comparison of EU Countries', *European Journal of Education*, Vol. 49, No. 4, pp., 543-557. https://doi.org/10.1111/ejed.12069

Agasisti, T. (2016) 'Cost Structure, Productivity and Efficiency of the Italian Public Higher Education Industry 2001–2011', *International Review of Applied Economics*, Vol. 30, No. 1, pp. 48–68. https://doi.org/10.1080/02692171.2015.1070130

Agasisti, T. (2017) 'Management of Higher Education Institutions and the Evaluation of their Efficiency and Performance', *Tertiary Education and Management*, Vol. 23, No. 3, pp. 187-190. https://doi.org/10.1080/13583883.2017.1336250

Agasisti, T. and Bonomi, F. (2014) 'Benchmarking Universities' Efficiency Indicators in the Presence of Internal Heterogeneity', *Studies in Higher Education*, Vol. 39, No. 7, pp. 1237-1255. https://doi.org/10.1080/03075079.2013.801423

Agasisti, T., Barra, C. and Zotti, R. (2016) 'Evaluating the Efficiency of Italian Public Universities (2008-2011) 'in Presence of (Unobserved) 'Heterogeneity', *Socio-Economic Planning Sciences*, Vol. 55, pp. 47-58. https://doi.org/10.1016/j.seps.2016.06.002

Agasisti, T., Catalano G., Landoni, P. and Verganti, R. (2012) 'Evaluating the performance of academic departments: an analysis of research-related output efficiency', *Research Evaluation*, Vol. 21, No. 1, pp. 2-14. https://doi.org/10.1093/reseval/rvr001

Agasisti, T. and Dal Bianco, A. (2006) 'Data Envelopment Analysis of the Italian University System: Theoretical and Policy Implications', *International Journal of Business Performance Management*, Vol. 8, No. 4, pp. 344-367. https://doi.org/10.1504/IJBPM.2006.009613

Agasisti, T. and Gralka, S. (2017) 'The Transient and Persistent Efficiency of Italian and German Universities: A Stochastic Frontier Analysis', *CEPIE Working Paper* 14/17.

Agasisti, T., and Haelermans, C. (2016) 'Comparing Efficiency of Public Universities among European Countries: Different Incentives Lead to Different Performances', *Higher Education Quarterly*, Vol. 70 , No. 1, pp. 81–104. https://doi.org/10.1111/hequ.12066

Agasisti, T. and Johnes, G. (2009) 'Beyond Frontiers: Comparing the Efficiency of Higher Education Decision-Making Units across More Than One Country', *Education Economics*, Vol. 171, No. 1, pp. 59-79. http://dx.doi.org/10.1080/09645290701523291

Agasisti, T. and Johnes, G. (2010) 'Heterogeneity and the Evaluation of Efficiency: the case of Italian Universities', *Applied Economics*, Vol. 42, No. 11, pp. 1365-1375. https://doi.org/10.1080/00036840701721463

Agasisti, T. and Johnes, G. (2013) 'Efficiency, Costs, Rankings and Heterogenity: the case of US Higher Education', *Studies in Higher Education*, Vol. 40, No. 1, pp. 21-37. https://doi.org/10.1080/03075079.2013.818644

Agasisti, T. and Pérez-Esparrells, C. (2010) 'Comparing Efficiency in a Cross-Country Perspective: The Case of Italian and Spanish State Universities', *Higher Education*, Vol. 59, No. 1, pp. 85-103. https://doi.org/10.1007/s10734-009-9235-8

Agasisti, T. and Salerno, C. (2007) 'Assessing the Cost Efficiency of Italian Universities', *Education Economics*, Vol. 15, No. 4, pp. 455-471. https://doi.org/10.1080/09645290701273491

Agasisti, T. and Wolszczak-Derlacz, J. (2016) 'Exploring efficiency differentials between Italian and Polish universities, 2001–11', *Science and Public Policy*, Vol. 43, No. 1, pp. 128-142. https://doi.org/10.1093/scipol/scv026

Aigner, D. J., Lovel, C.A.K. and Schmidt, P. (1977) 'Formulation and Estimation of Stochastic Frontier Production Function Models', *Journal of Econometrics*, Vol. 6, No. 1, pp. 21-37. https://doi.org/10.1016/0304-4076(77)90052-5

Andersson, C., Antelius, J., Mansson, J. and Sund, K. (2016) 'Technical Efficiency and Productivity for Higher Education Institutions in Sweden', *Scandinavian Journal of Educational Research*, Vol. 61, No. 2, pp. 205-223. https://doi.org/10.1080/00313831.2015.1120230

Athanassopoulos, A.D. and Shale, E. (1997) 'Assessing the Comparative Efficiency of Higher Education Institutions in the UK by the Means of Data Envelopment Analysis', *Education Economics*, Vol. 5, No. 2, pp. 117-134, http://dx.doi.org/10.1080/09645299700000011

Avkiran, N.K. (2001) 'Investigating Technical and Scale Efficiencies of Australian Universities through Data Envelopment Analysis', *Socio-Economic Planning Sciences*, Vol. 35, No. 1, pp. 57-80. https://doi.org/10.1016/S0038-0121(00)00010-0

Badunenko, O. and Kumbhakar, S.C. (2016) 'When, Where and How to Estimate Persistent and Transient Efficiency in Stochastic Frontier Panel Data Models', *European Journal of Operational Research*, Vol. 225, No. 1, pp. 272–287. https://doi.org/10.1016/j.ejor.2016.04.049

Barra, C., Lagravinese, R. and Zotti, R. (2018) 'Does Econometric Methodology Matter to Rank Universities? An Analysis of Italian Higher Education System', *Socio-Economic Planning Sciences*, Vol. 62, pp. 104-120. https://doi.org/10.1016/j.seps.2017.09.002

Barra, C. and Zotti R. (2016a) 'A Directional Distance Approach Applied to Higher Education: An Analysis of Teaching-Related Output Efficiency', *Annals of Public and Cooperative Economics*, Vol. 87, No. 2, pp. 145-173. https://doi.org/10.1111/apce.12091

Barra, C. and Zotti R. (2016b) 'Measuring Efficiency in Higher Education: An Empirical Study Using a Bootstrapped Data Envelopment Analysis', *International Advances in Economic Research*, Vol. 22, pp. 11-33. https://doi.org/10.1007/s11294-015-9558-4

Banker, R., Charnes, A. and Cooper, W.W. (1984) 'Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis', *Management Science*, Vol. 30, No. 9, pp. 1078–1092. https://doi.org/10.1287/mnsc.30.9.1078

Battese, G.E., and Coelli, T.J. (1988) 'Prediction of firm-level technical efficiencies with generalized frontier production function and panel data', *Journal of Econometrics*, Vol. 38, No. 3, pp. 387-399. https://doi.org/10.1016/0304-4076(88)90053-X

Battese, G.E. and Coelli, T.J. (1992) 'Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India', *Journal of Productivity Analysis*, Vol. 3, No. 1-2, pp. 153-169. https://doi.org/10.1007/BF00158774

Battese, G.E. and Coelli, T.J. (1995) 'A model for technical inefficiency effects in a stochastic frontier production function for panel data', *Empirical Economics*, Vol. 20, pp. 325-332. https://doi.org/10.1007/BF01205442

Bauer P.W., Berger, A.N., Ferrier, G.D. and Humphrey, D.B. (1998) 'Consistency Conditions for Regulatory Analysis of Financial Institutions: A Comparison of Frontier Efficiency Methods', *Journal of Economics and Business*, Vol. 50, No. 2, pp. 85-114. https://doi.org/10.1016/S0148-6195(97)00072-6

Berbegal-Mirabent, J. (2018) 'The influence of regulatory frameworks on research and knowledge transfer outputs: An efficiency analysis of Spanish public universities', *Journal of Engineering and Technology Management*, Vol. 47, pp. 68-80. https://doi.org/10.1016/j.jengtecman.2018.01.003

Berbegal-Mirabent, J., Lafuente, E. and Solé, F. (2013) 'The pursuit of knowledge transfer activities: An efficiency analysis of Spanish universities', *Journal of Business Research* Vol. 66, No. 10, pp. 2051-2059. https://doi.org/10.1016/j.jbusres.2013.02.031

Cantele, S., Guerrini, A. and Campedelli, B. (2016) 'Efficiency of Italian Universities: The Effect of Controllable and Non-Controllable Environmental and Operational Variables', *International Journal of Public Policy*, Vol. 12, No. 3-6, pp. 243-260. https://doi.org/10.1504/IJPP.2016.079737

Castano, M.C.N. and Cabanda, E.C. (2007) 'Performance Evaluation of the Efficiency of Philippine Private Higher Educational Institutions: Application of Frontier Approaches', *International Transactions in Operational Research*, Vol. 14, No. 5, pp. 431–444. https://doi.org/10.1111/j.1475-3995.2007.00599.x

Caudill, S., and Ford, J. (1993) 'Biases in frontier estimation due to heteroscedasticity', *Economic Letters*, Vol. 41, No. 1, pp. 17-20. https://doi.org/10.1016/0165-1765(93)90104-K

Caudill, S., Ford, J. and Gropper, D. (1995) 'Frontier estimation and firm-specific inefficiency measures in the presence of heteroscedasticity', *Journal of Business Economics and Statistics*, Vol. 13, No. 1, pp. 105-111. https://dx.doi.org/10.2307/1392525

Charnes, A., Cooper, W.W. and Rhodes, E. (1978) 'Measuring the Efficiency of Decision- Making Units', *European Journal of Operational Research*, Vol. 2, No. 6, pp. 429–444. https://doi.org/10.1016/0377-2217(78)90138-8

Coelli, T., Rao, D.S.P, O'Donnell, C.J. and Battese, G. (2005) '*An Introduction to Efficiency and Productivity Analysis*', New York, NY: Springer. https://doi.org/10.1007/978-1-4615-5493-6

Cohn, E. and Cooper, S. T. (2004) 'Multi-Product Cost Functions for Universities: Economies of Scale and Scope', in Geraint J. and Johnes J. (eds.) *International Handbook on the Economics of Education*, Northampton, MA: Edgar Elgar Publishing.

Cornwell, C., Schmidt, P. and Sickles, R.C. (1990) 'Production Frontiers with Time-Series Variation in Efficiency Levels', *Journal of Econometrics*, Vol. 46, No. 1-2, pp. 185–200. https://doi.org/10.1016/0304-4076(90)90054-W

Costa, E. M., Ramos, F. S. and de Souza, H. R. (2011) 'The Productive Efficiency of Federal Institutions of Brazilian Higher Education', *Encontro ANPEC 2011*.

Daraio, C., Bonaccorsi, A. and Simar, L. (2015) 'Efficiency and Economies of Scale and Specialization in European Universities: A Directional Distance Approach', *Journal of Infometrics*, Vol. 9, No. 3, pp. 430-448. https://doi.org/10.1016/j.joi.2015.03.002

Das, S. and Das M. (2014) 'Technical Efficiency and Performance of the Higher Educational Institutions: A Study of Affiliated Degree Colleges of Barak Valley in Assam', *Journal of Social and Economic Policy*, Vol. 11, No. 1, pp. 59–70.

De Fraja, G. and Valbonesi, P. (2012) 'The Design of the University System', *Journal of Public Economics*, Vol. 96, No. 3-4, pp. 317-330. https://doi.org/10.1016/j.jpubeco.2011.10.005

De Witte, K. and López-Torres L. (2017) 'Efficiency in education: a review of literature and a way forward', *Journal of the Operational Research Society*, Vol. 68, No. 4, pp. 339-363. https://doi.org/10.1057/jors.2015.92

D'Elia, V. and G. Ferro (2019) 'Empirical Efficiency Measurement in Higher Education: An Overview', *Serie Documentos de Trabajo* 708, Universidad del CEMA (UCEMA)

D'Elia, V. and Ferro, G. (2020) 'Efficiency in Public Higher Education: A Stochastic Frontier Analysis Considering Heterogeneity', *Revista de Análisis Económico - Economic Analysis Review* [In Press]

Dyson, R.G., Allen, R., Camanho, A.S., Podinovski, V.V., Sarrico, C.S. and Shale, E.A. (2001) 'Pitfalls and Protocols in DEA', *European Journal of Operational Research*, Vol. 132, No. 2, 245-259. http://dx.doi.org/10.1016/S0377-2217(00)00149-1

Eagan, K. and Titus M.A. (2016) 'Examining Production Efficiency in Higher Education: The Utility of Stochastic Frontier Analysis'. In *Higher Education: Handbook of Theory and Research*. New York, NY: Springer.

Erkoc, T. E. (2015) 'Assessing the Research Performance in Higher Education with Stochastic Distance Function Approach', *International Journal of Education Economics and Development*, Vol. 6, No. 4, pp. 366-380. http://dx.doi.org/10.1504/IJEED.2015.075797

Ferreyra, M. M., Avitabile, C., Botero Álvarez, J., Haimovich Paz, F. and Urzúa, S. (2017) *At a Crossroads. Higher Education in Latin America and the Caribbean*, Washington, DC: Directions in Development. Human Development. World Bank Group. https://doi.org/10.1596/978-1-4648-1014-5

Filippini, M. and Greene, W. (2016) 'Persistent and Transient Productive Inefficiency: A Maximum Simulated Likelihood Approach', *Journal of Productivity Analysis*, Vol. 45, No. 2, pp. 187–196. https://doi.org/10.1007/s11123-015-0446-y

Flegg, A. T. and Allen, D.O. (2007) 'Does Expansion Cause Congestion? The Case of the Older British Universities, 1994-2004', *Education Economics*, Vol. 15, No. 1, pp. 75-102. https://doi.org/10.1080/09645290601133928

Flegg, A.T., Allen, D.O., Field, K. and Thurlow, T.W. (2004) 'Measuring the Efficiency of British Universities: A Multi Period Data Envelopment Analysis', *Education Economics*, Vol. 12, No. 3, pp. 231-249. http://dx.doi.org/10.1080/0904529042000258590

Flégl, M., and Vltavská, K. (2013) 'Efficiency at Faculties of Economics in the Czech Public Higher Education Institutions: Two Different Approaches', *International Education Studies*, Vol. 6, No. 10, pp. 1-12. http://dx.doi.org/10.5539/ies.v6n10p1

Furková, A. (2013) 'Alternative Approaches to Efficiency Evaluation of Higher Education Institutions', *Journal on Efficiency and Responsibility in Education and Science*, Vol. 6, No. 3, pp. 167-178. https://doi.org/10.7160/eriesj.2013.060304

Gates, S. and Stone A. (1997) *Understanding Productivity in Higher Education*, Prepared for California Education Roundtable. Institute on Education and Training. RAND.

Gralka, S. (2018a) 'Stochastic Frontier Analysis in Higher Education: A Systematic Review', *CEPIE Working Paper* 05/18. Center of Public and International Economics. Technische Universität Dresden.

Gralka, S. (2018b) 'Persistent Inefficiency in the Higher Education Sector: Evidence from Germany', *Education Economics*, Vol. 26, No. 4, pp. 373–392. https://doi.org/10.1080/09645292.2017.1420754

Greene, W. (2005a) 'Reconsidering heterogeneity in panel data estimators of the stochastic frontier model', *Journal of Econometrics*, Vol. 126, No. 2, pp. 269-303. https://doi.org/10.1016/j.jeconom.2004.05.003

Greene, W. (2005b) 'Fixed random effects in stochastic frontier models', *Journal of Productivity Analysis*, Vol. 23, No. 1, pp. 7-32. https://doi.org/10.1007/s11123-004-8545-1

Greene, W. (2008) 'The econometric approach to efficiency analysis', in Fried, H.O. Knox Lovell C.A. and Schmidt S.S. (eds.) *The Measurement of Productive Efficiency and Productivity Growth*. New York: Oxford University Press.

Guccio, C., Martorana, M.F. and Monaco, L. (2016) 'Evaluating the Impact of the Bologna Process on the Efficiency Convergence of Italian Universities: A Non-Parametric Frontier Approach', *Journal of Productivity Analysis*, Vol. 45, No. 3, pp. 275-298. https://doi.org/10.1007/s11123-015-0459-6

Hadri, K. (1999) 'Estimation of a Doubly Heteroscedastic Stochastic Frontier Cost Function', *Journal of Business Economics and Statistics*, Vol. 17, No. 3, pp. 359-363. https://doi.org/10.1007/10.1080/07350015.1999.10524824

Horne, J. and Hu, B. (2008) 'Estimation of Cost Efficiency of Australian Universities', *Mathematics and Computing in Simulation*, Vol. 78, No. 2-3, pp. 266-275. https://doi.org/10.1016/j.matcom.2008.01.018

Izadi, H., Johnes G., Oskrochi, R. and Crouchley, R. (2002) 'Stochastic Frontier Estimation of a CES Cost Function: The Case of Higher Education in Britain', *Economics of Education Review*, Vol. 21, No. 1, pp. 63-71. https://doi.org/10.1016/S0272-7757(00)00044-3

Johnes, G. and Johnes, J. (2009) 'Higher Education Institutions' Costs and Efficiency: Taking the Decomposition a Further Step', *Economics of Education Review*, Vol. 28, No. 1, pp. 107-113. https://doi.org/10.1016/j.econedurev.2008.02.001

Johnes, G., Johnes, J. and Thanassoulis, E. (2008) 'An Analysis of Costs in Institutions of Higher Education in England', *Studies in Higher Education*, Vol. 33, No. 5, pp. 527-549. https://doi.org/10.1080/03075070802372901

Johnes, G., and Salas-Velasco, M. (2007) 'The Determinants of Costs and Efficiencies Where Producers Are Heterogeneous: The Case of Spanish Universities', *Economics Bulletin*, Vol. 4, No. 15, pp. 1–9.

Johnes, G. and Schwarzenberger A. (2011) 'Differences in Cost Structure and the Evaluation of Efficiency: The Case of German Universities', *Education Economics*, Vol. 19, No. 5, pp. 487-499. https://doi.org/10.1080/09645291003726442

Johnes, G. and Tone, K. (2016) 'The Efficiency of Higher Education Institutions in England Revisited: Comparing Alternative Measures', *Tertiary Education and Management*, Vol. 23, No. 3, pp. 191-205. https://doi.org/10.1080/13583883.2016.1203457

Johnes, J. (2006a) 'Data Envelopment Analysis and its Application to the Measurement of Efficiency in Higher Education', *Economics of Education Review*, Vol. 25, No. 3, pp. 273-288. https://doi.org/10.1016/j.econedurev.2005.02.005

Johnes, J. (2006b) 'Measuring Teaching Efficiency in Higher Education: An Application of Data Envelopment Analysis to Economics Graduates from UK Universities 1993', *European Journal of Operational Research*, Vol. 174, No. 1, pp. 443-456. https://doi.org/10.1016/j.ejor.2005.02.044

Johnes, J. (2008) 'Efficiency and Productivity Change in the English Higher Education Sector from 1996/97 to 2004/05', *The Manchester School*, Vol. 76, No. 6, pp. 653-674. https://doi.org/10.1111/j.1467-9957.2008.01087.x

Johnes, J. (2004) *Efficiency Measurement.* in Geraint J. and Johnes J. (eds.) *International Handbook on the Economics of Education*, Northampton, MA: Edgar Elgar Publishing.

Johnes, G. and Johnes, J. (1993) 'Measuring the Research Performance of UK Economics Departments: An Application of Data Envelopment Analysis', *Oxford Economic Papers*, Vol. 45, No. 2, pp. 332-347. https://doi.org/10.1093/oxfordjournals.oep.a042095

Johnes, J. and Yu, L. (2008) 'Measuring the Research Performance of Chinese Higher Education Institutions Using Data Envelopment Analysis', *China Economic Review*, Vol. 19, No. 4, pp. 679-696. https://doi.org/10.1016/j.chieco.2008.08.004

Kao, C. and Hung, H.-T. (2008) 'Efficiency Analysis of University Departments: An Empirical Study', *Omega*, Vol. 36, No. 4, pp. 653-664. https://doi.org/10.1016/j.omega.2006.02.003

Katharaki, M. and Katharakis, G. (2010) 'A Comparative Assessment for Greek Universities' Efficiency Using Quantitative Analysis', *International Journal of Educational Research*, Vol. 49, No. 4-5, pp. 115-128. https://doi.org/10.1016/j.ijer.2010.11.001

Kempkes, G. and Pohl, C. (2010) 'The Efficiency of German Universities. Some Evidence from Non-Parametric and Parametric Methods', *Applied Economics*, Vol. 42, No. 16, pp. 2063-2079. https://doi.org/10.1080/00036840701765361

Kuah, C.T. and Wong, K.Y. (2011) 'Efficiency Assessment of Universities through Data Envelopment Analysis', *Procedia Computer Science*, Vol. 3, pp. 499-506. https://doi.org/10.1016/j.procs.2010.12.084

Kumbhakar, S.C. (1990) 'Production frontiers, panel data and time-varying technical inefficiency', *Journal of Econometrics*, Vol. 46, No. 1-2, pp. 201-212. https://doi.org/10.1016/0304-4076(90)90055-X

Kumbhakar, S.C. and Heshmati, A. (1995) 'Efficiency Measurement in Swedish Dairy Farms: An Application of Rotating Panel Data', *American Journal of Agricultural Economics*, Vol. 77, No. 3, pp. 660–674. https://doi.org/10.2307/1243233

Kumbhakar, S.C., Lien, G. and Hardaker, J.B. (2014) 'Technical Efficiency in Competing Panel Data Models: A Study of Norwegian Grain Farming', *Journal of Productivity Analysis*, Vol. 41, No. 2, pp. 321–337. https://doi.org/10.1007/s11123-012-0303-1

Kuo, J.-S. and Ho, Y.-C. (2008) 'The Cost Efficiency Impact of the University Operation Fund in Taiwan', *Economics of Education Review*, Vol. 27, No. 5, pp. 603-612. https://doi.org/10.1016/j.econedurev.2007.06.003

Laureti, T., Secondi, L. and Biggeri, L. (2014) 'Measuring the Efficiency of Teaching Activities in Italian Universities: An Information Theoretic Approach', *Economics of Education Review*, Vol. 42, pp. 147-164. https://doi.org/10.1016/j.econedurev.2014.07.001

Lee Y. H. and Schmidt, P. (1993) 'A Production Frontier Model with Flexible Temporal Variation in Technical Efficiency, in Fried H.O. and Schmidt S.S. (eds.) *The Measurement of Productive Efficiency: Techniques and Applications*, Oxford U.K. pp. 237-255.

Lee, B.L. and Worthington, A.C. (2016) 'A Network DEA Quantity and Quality-Oriented Production Model: An Application to Australian University Research Services', *Omega*, Vol. 60, pp. 26-33. https://doi.org/10.1016/j.omega.2015.05.014

Marinho, A., Resende M. and Façanha L. O. (1997) 'Brazilian Federal Universities: Relative Efficiency Evaluation and Data Envelopment Analysis', *Revista Brasileira de Economia*, Vol. 51, No. 4, pp. 489-508.

Martín, E. (2006) 'Efficiency and Quality in the Current Higher Education Context in Europe: An Application of the Data Envelopment Analysis Methodology to the Performance Assessment of the Departments at the University of Zaragoza', *Quality in Higher Education*, Vol. 12, No. 1, pp. 57-79. http://dx.doi.org/10.1080/13538320600685172

Mensah, Y.M. and Werner, R. (2003) 'Cost Efficiency and Financial Flexibility in Institutions of Higher Education', *Journal of Accounting and Public Policy*, Vol. 22, No. 4, pp. 293-323. https://doi.org/10.1016/S0278-4254(03)00036-X

Mamun, S. A. K. (2011) 'Are Public Universities of Bangladesh Cost Efficient? An Empirical Evidence', *South Asia Economic Journal*, Vol. 12, Vol. 2, pp. 221–237. https://dx.doi.org/10.1177/139156141101200202

Meeusen, W. and van den Broeck, J. (1977) 'Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error', *International Economic Review*, Vol. 18, No. 2, pp. 435-444.

Mikušová, P. (2017) 'Measuring the Efficiency of the Czech Public Higher Education Institutions: An Application of DEA', *Journal on Efficiency and Responsibility in Education and Science*, Vol. 10, No. 2, pp. 58-63. https://doi.org/10.7160/eriesj.2017.100204

Millot, B. (2015) 'International Rankings: Universities vs. Higher Education Systems', *International Journal of Educational Development*, Vol. 40, pp. 156-165. https://doi.org/10.1016/j.ijedudev.2014.10.004

Pitt, M.M. and Lee, L.-F. (1981) 'The measurement and sources of technical inefficiency in the Indonesian weaving industry', *Journal of Development Economics*, Vol. 9, No. 1, pp. 43-64. https://doi.org/10.1016/0304-3878(81)90004-3

Ray, S.C. (2004) *Data Envelopment Analysis Theory and Techniques for Economics and Operations Research*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511606731

Rhaiem, M. (2017) 'Measurement and Determinants of Academic Research Efficiency: A Systematic Review of the Evidence', *Scientometrics*, Vol. 110, No. 2, pp. 581-615. https://doi.org/10.1007/s11192-016-2173-1

Robst, J. (2001) 'Cost Efficiency in Public Higher Education Institutions', *The Journal of Higher Education*, Vol. 72, No. 6, pp. 730–750. https://dx.doi.org/10.2307/2672901

Russell R. (2018) 'Theoretical productivity indexes', in Griell-Tajté, E.,. Knox Lovell C. A and Sickles R. (eds.) *The Oxford Handbook for Productivity Analysis*. New York, NY: Oxford Handbooks.

Salerno, C. (2003) 'What we know about the efficiency of higher education institutions: the best evidence', *Unpublished Report*.

Sav, G.T. (2011) 'Cost Efficiencies and Rankings of Flagship Universities', *American Journal of Economics and Business Administration*, Vol. 3, No. 4, pp. 596–603. https://doi.org/10.3844/ajebasp.2011.596.603

Sav, G.T. (2012a) 'Efficiency Estimates and Rankings Employing Data Envelopment and Stochastic Frontier Analyses: Evaluating the Management of U.S. Public Colleges', *Information Management and Business Review*, Vol. 4, No. 8, pp. 444–452. https://doi.org/10.22610/imbr.v4i8.999

Sav, G.T. (2012b) 'Frontier and Envelopment Evaluations of University Graduation Efficiencies and Productivities: Elements for Performance Based Funding', *Problems and Perspectives in Management*, Vol. 4, No. 4, pp. 71–79.

Sav, G.T. (2012c) 'Cost Inefficiencies and Rankings of Ivy Universities: Stochastic Panel Estimates', *International Journal of Economics and Finance*, Vol. 4, No. 3, pp. 3–12. https://dx.doi.org/10.5539/ijef.v4n3p3

Sav, G.T. (2012d) 'Stochastic Cost Inefficiency Estimates and Rankings of Public and Private Research and Doctoral Granting Universities', *Journal of Knowledge Management, Economics, and Information Technology*, Vol. 2, No. 3, pp. 1–20.

Sav, G.T. (2012e) 'Managing Operating Efficiencies of Publicly Owned Universities: American University Stochastic Frontier Estimates Using Panel Data', *Advances in Management and Applied Economics*, Vol. 2, No. 1, pp. 1–23.

Sav, G.T. (2012f) 'Minority Serving College and University Cost Efficiencies, Vol. 8, No. 1, pp. 54–60.

Sav, G.T. (2012g) 'For-Profit College Entry and Cost Efficiency: Stochastic Frontier Estimates versus Two-Year Public and Non-Profit Colleges', *International Business Research*, Vol. 5, No. 3, pp. 26–32. https://dx.doi.org/10.5539/ibr.v5n3p26

Sav, G.T. (2012h) 'Is the Production of Religious Knowledge Efficient? Managing Faith Related Postsecondary Institutions', *Journal of Knowledge Management, Economics, and Information Technology*, Vol. 2, No. 1, pp. 1–13.

Sav, G.T. (2012i) 'Stochastic Cost Frontier and Inefficiency Estimates of Public and Private Universities: Does Government Matter?', *International Advances in Economic Research*, Vol. 18, No. 2, pp. 187–198. https://dx.doi.org/10.1007/s11294-012-9353-4

Sav, G.T. (2012j) 'Historically Black College and University Operating Cost Efficiencies: Stochastic Cost Estimates and Comparisons to Predominately White Institutions', *International Journal of Education Economics and Development*, Vol. 3, No. 3, pp. 252–263. https://dx.doi.org/10.1504/IJEED.2012.049177

Sav, G.T. (2012k) 'Does Faculty Tenure Improve Student Graduation Rates?', *Journal of Business Management and Applied Economics*, Vol. 1, No. 5, pp. 1–19.

Sav, G.T. (2012l) 'Female Faculty, Tenure, and Student Graduation Success: Efficiency Implications for University Funding', *International Journal of Business Management & Economic Research*, Vol. 3, No. 6, pp. 633–640.

Sav, G.T. (2016) 'Declining State Funding and Efficiency Effects on Public Higher Education: Government Really Does Matter', *International Advances in Economic Research*, Vol. 22, No. 4, pp. 397–408. https://doi.org/10.1007/s11294-016-9602-z

Schmidt, P. and Sickles, R. (1984) 'Production frontiers and panel data', *Journal of Business Economics and Statistics*, Vol. 2, No. 4, pp. 367-374. https://dx.doi.org/10.2307/1391278

Selim, S. and Bursalioglu, S.A. (2013) 'Analysis of the Determinants of University Efficiency in Turkey: Application of the Data Envelopment Analysis and Panel Tobit Model', *Procedia – Social and Behavioral Sciences*, Vol. 89, pp. 895-200. https://doi.org/10.1016/j.sbspro.2013.08.952

Simar, L. and Wilson P. W. (2007) 'Estimation and inference in two-stage semi-parametric models of production processes', *Journal of Econometrics*, Vol. 136, No. 1, pp. 31–64. https://doi.org/10.1016/j.jeconom.2005.07.009

Titus, M.A., Vamosiu, A. and McClure, K.R. (2016) 'Are Public Master's Institutions Cost Efficient? A Stochastic Frontier and Spatial Analysis', *Research in Higher Education*, Vol. 58, No. 5, pp. 469–496. https://doi.org/10.1007/s11162-016-9434-y

Tsionas, E.G. and Kumbhakar, S.C. (2014) 'Firm Heterogeneity, Persistent and Transient Technical Inefficiency: A Generalized True Random-Effects Model', *Journal of Applied Econometrics*, Vol. 29, No. 1, pp. 110–132. https://doi.org/10.1002/jae.2300

Warning, S. (2004) 'Performance Differences in German Higher Education: Empirical Analysis of Strategic Groups', *Review of Industrial Organization*, Vol. 24, No. 4, pp. 393-408. http://dx.doi.org/10.1023/B:REIO.0000037538.48594.2c

Wolff, E.N., Baumol, W.J. and Saini, A.N. (2014) 'A Comparative analysis of Education Costs and Outcomes: The United States vs. Other OECD Countries', *Economics of Education Review*, Vol. 39, pp. 1-21. https://doi.org/10.1016/j.econedurev.2013.12.002

Wolszczak-Derlacz, J. (2017) 'An evaluation and explanation of (in) efficiency in higher education institutions in Europe and the U.S. with the application of two-stage semi-parametric DEA', *Research Policy*, Vol. 46, No. 9, pp. 1595-1605. https://doi.org/10.1016/j.respol.2017.07.010

Worthington, A. (2001) 'An Empirical Survey of Frontier Efficiency Measurement Techniques in Education', *Education Economics*, Vol. 9, No. 3, pp. 245-268.

Worthington, A. and Lee, B.L. (2008) 'Efficiency, Technology and Productivity Change in Australian Universities, 1998-2003', *Economics of Education Review*, Vol. 27, No. 3, pp. 285-298. https://doi.org/10.1016/j.econedurev.2006.09.012

Zoghbi, A.C., Rocha, F. and Mattos, E. (2013) 'Education Production Efficiency: Evidence from Brazilian Universities', *Economic Modelling*, Vol. 31, pp. 94-103. https://doi.org/10.1016/j.econmod.2012.11.018

AVOIDING PUBLISHING IN PREDATORY JOURNALS: AN EVALUATION ALGORITHM

Albana Berisha Qehaja

University of Prishtina, The Republic of Kosova

albana.berisha@uni-pr.edu

ABSTRACT

Academics and scholars need to publish their research results. In addition, they are required to publish scientific papers to prove their research commitment and to achieve certain academic titles in higher education institutions. Globally, there are many scientific journals of well-known publishing houses/universities, which offer opportunities to publish scientific work. One of the recent topics in academic circles is the increasing number of invitations to publish articles via quick procedures, without going through the adequate review process. This phenomenon is threatening academic integrity, as these publishers/journals aim at financial benefits and not contributing to scientific development and progress. There is a gap in the knowledge of the scientific researchers regarding the journal selection to publish their work. Some of them are still unintentionally publishing in such journals, mainly as a lack of information about them. The main purpose of this study is awareness-raising, warning, and guidance of scientific researchers, particularly young researchers by providing information on how to avoid submitting manuscripts in these journals. To achieve this, we have consulted the recent literature and practices of different countries, summarized the most used tools/methods to identify predatory publishers and journals, and lastly, we have developed a guiding algorithm for evaluating them.

KEYWORDS

Blacklists, manuscript, open access, predatory journal, predatory publisher, scientific journal, whitelists

HOW TO CITE

Berisha Qehaja A. (2020) 'Avoiding publishing in predatory journals: An evaluation algorithm', *Journal on Efficiency and Responsibility in Education and Science*, vol. 13, no. 3, pp. 154-163. http://dx.doi.org/10.7160/eriesj.2020.130305

Article history
Received
June 11, 2020
Received in revised form
July 5, 2020
Accepted
September 4, 2020
Available on-line
September 30, 2020

Highlights

- *Provision of information for recognizing and avoiding publishing in predatory journals.*
- *The most used tools and methods to identify predatory publishers/journals.*
- *A proposed algorithm for evaluating publishers/journals.*

INTRODUCTION

Advances in contemporary science depend on the distribution of valuable and credible scientific papers, whereas the academic journal industry depends on a system where competent academics willingly assess the other scholars' manuscripts. This correction (vetting) process, also known as peer review, highlights the ethical and quality lack in manuscripts. Authors usually benefit from this process because reviewers make recommendations that improve the quality of their manuscripts (Umlauf and Mochizuki, 2018).

The concept of predatory publishing has been widely known since its introduction years ago by librarian Jeffrey Beall (Xia, 2015). Except "*predatory journals*" used by Beall (2010), these journals are known also as "*hijacked journals*" (Jalalian, 2012; cited by Jalalian and Dadkhah, 2015), "*dark side of publishing*" (Butler, 2013), "*ghost journals*" (Memon, 2016). The names "*fake journals*" "*sham journals*" and "*pseudojournals*" are also used (Berger, 2017). Despite their naming, Laine and Winker (2017) emphasize that such journals do not apply the peer review process, which is a distinctive feature of scientific publications.

Academic journals have multiplied very rapidly in recent years, especially those with open access (hereinafter often referred to as OA). Among them, the quantity of "*predatory*" journals has increased too. The latter have shown deceitful tendencies, scientific rigor deficiency, and their purpose is mainly the financial benefit (Kurt, 2018). Umlauf and Mochizuki (2018: 2) describe this phenomenon as follows 'This profit-driven scheme bypasses peer review and promises quick publication, but only after the author pays a fee. When a manuscript is poorly written or the science poorly designed, this arrangement is ideal. On the other hand, honest and mistaken authors who discover their error and seek to withdraw their papers later cannot.'

It is considered that predatory journals are the most widely spread category of pseudo journals, and recently they had significant growth (Laine and Winker, 2017). A total of 8,000 active predatory journals published about 420,000 articles in 2014, following a pretty linear increase from 53,000 in 2010 (Shen and Björk, 2015). As stated by Frandsen (2017), possible explanations for the rapid growth are deceptive measures, titles of journals analogous to the titles of esteemed journals, and the "presence" of academics/scientists from top universities and research institutes. According to Beall (2013: 84), 'there are millions of researchers around the world desperate to publish, and the predatory publishers are eager to have them as customers.'

Berger (2017: 206) describes the predatory publishing as 'as low quality, amateurish, and often unethical academic publishing that is usually Open Access (OA).' Whereas, Umlauf and Mochizuki (2018) point out that the consequences of publishing in predatory journals for honest researchers are: wasting time, using data in vain, wasted money and manuscripts that end up not being indexed or archived on proper databases. Thus, the identification of these journals is very crucial for writers, scholars, reviewers, and editors, because manuscripts that do not go through the proper review process should not be included in the register of scientific data (Laine and Winker, 2017).

Hereupon, the main purpose of this study is awareness-raising, warning, and guidance of scientific researchers, particularly young researchers by providing information on how to avoid manuscript submitting in these journals. Accordingly, the following research tasks have been set:

- reviewing the literature on predatory publishers and journals,
- summarizing the most used tools/methods to identify predatory publishers and journals and,
- developing a guiding algorithm for evaluating publishers and journals.

We believe that this paper will offer significant guidance on avoiding publishing in predatory journals. The paper is organized into five main sections. The first section provides a brief literature review on predatory publishers and journals, their characteristics, open access, article processing charges, and Bohannon's experiment. Then it proceeds with materials and methods of the paper. Further, section three presents results, to continue with discussion in the fourth section. In the last section, the conclusion is summarized and the limitations and suggestions for future work are given as well.

LITERATURE REVIEW

Over the past decade, a group of scientific journals has spread rapidly and has become known as a group of "*predatory journals*" published by "*predatory publishers*" (Laine and Winker, 2017). Subsequently, the research community has fallen victim to cybercrime. According to Memon (2016: 1644), 'this academic pollution had targeted many scientists after the emergence of predatory and hijacked journals.'

Xia et al (2015) point out that rarely you can find a scholar who has not received spam e-mails from a fraudulent journal/conference, which tends to inductee papers/participation. They may also have received emails that invite them to engage in the "peer-review" process or to join the editorial board of a particular journal. Whereas according to Greco (2016), scholars who intentionally choose to send their work to predatory journals, particularly those in developing countries, are likely trying to find better work, promotion, or research grants (as cited by Umlauf and Mochizuki, 2018).

The open access movement (OA) and article processing charges (APCs)

Berger (2017: 208) thinks that 'predatory publishing arose from two conditions: the availability of journal publishing platforms and potential revenue from author-paid article processing charges (APCs) for OA.' Whereas, Bolick et al (2017) consider that the OA is more appropriate than the traditional closed-ended publication for the needs and participation in a progressively scientific research community. Also, the peer reviewers from a wider community can often be harsher, replying to the progressively multidisciplinary essence of contemporary study. Moreover, Kurt (2018) explains that the conception of open access has to do with the permitting of research outcomes to be disposable free of charge to all. While open access is an initiative with good intention, however, the essence of its open-source has exacerbated some problems, facilitating the imitation of legitimate journals by predatory journals.

Richtig et al (2018) explain several different APCs models (hereinafter often referred to as APCs). The "gold" open access model (OA) obliges the researcher to spend up to a lot of money to maintain copyright in the work, to guarantee that the content is completely and openly accessible online so that it can be shared with anyone. Then, the "green" OA model constrains the copyright to the distribution, where researchers can only distribute their papers over a personal website or third-party archiving pages. There are as well other kinds of created models as hybrid access, where researchers make a payment for open access to a subscription-based journal. However, despite subscription-based journals that impose low taxes upon the article acceptance, researchers that send their work to open-access journals must make an additional payment of a considerable sum for publication as well, which is named the APCs.

Certainly, the predatory publishing model is built on APCs (Berger, 2017). Until 2010 most of the articles were in print versions. Those journals had begun offering their free electronic version. Whereas since 2011, journals that were only online demanded payment for article processing and grew into the dominant group. Furthermore, the participation of papers in journals based merely online has risen promptly (Björk, 2017). Today, papers and journals can be available online or in hybrid formats. As Umlauf and Mochizuki (2018) quote from statistics presented by Teixeira da Silva (2015), in 2015 predatory

publishers published over 500,000 dubious manuscripts (in 8,000 predatory journals) and generated $75 million. That same year, legitimate publishers generated $335 million in total revenue.

Globally, there are around 20,000 OA journals that claim to be academic and have a peer-review process. Of these, approximately 9,000 are listed in the Directory of Open Access Journals (hereinafter often referred to as DOAJ). But many of them, specifically the small ones that are published outside of North America and Western Europe and are published in other languages and not in English, are not part of it.

Also according to Shen and Björk (2015), there are about 10,000 doubtful journals published by predatory publishers. These journals have already been removed from the DOAJ list. Whereas, Kozak and Hartley (2013) studied over 9,000 OA journals included in the DOAJ, and proved that only 28% of them have requested the APCs. On the contrary, the study of Xia (2015) examined OA predatory payments policies, which were listed on *scholarlyoa.com* at the time. He analyzed 298 predatory journals and compared the number of journals that took APCs (214) with the percentage of those listed in DOAJ. He determined links among the practices of predatory journals and the APCs. This study found that roughly 72% of predatory journals charge a fee for processing articles. This finding is considered higher compared to all earlier outcomes.

Bohannon (2013) found that out of a total of 255 articles that were subject to the review process for acceptance or rejection, nearly 60% of them were accepted without undergoing the real process of review.

According to Kurt (2018: 144) 'beyond costs and peer review processes, though, there are further points that typically separate legitimate OA journals from predatory OA journals, such as the following:

a) legitimate OA journals are usually (though not always) affiliated with an established scholarly society or academic institution; b) have dedicated editors, editorial staff, and peer reviewers who are also experts in their fields (though peer reviewers may not be named on OA sites, to preserve the anonymity of the process); c) share information about their publication fees and explain how these fees are used to support the journal; d) usually indexed by multiple scholarly databases, and e) outline the scope of their publication on their website for potential authors to access and see whether their work actually meets the publication's subject matter requirements.'

Characteristics of predatory journals

It is considered that after the publication rate increased and a lot of improvements were made in the research field, the academic community began to be attacked and to fall victim to cybercrime. This was manifested as ghost journals, fake publishers and magic impact measures (Memon, 2016). Several authors have written about the characteristics of predatory journals. Except those of Kurt (2018) precised in the earlier paragraph, we have summarized the detailed characteristics of predatory journals by Berger (2017) and Shamseer et al (2017) (Table 1).

Berger (2017) states that among the main features of predatory journals are: deceitful emails sent to addresses ending in ".edu", to invite potential authors for journals/conferences; promises of fast peer review and fast publication; lack of focus on a particular field or very broad field; lack of transparency about author fees; contradictions and inconsistencies; editors are not editors; newness and quantity; copycat names with and without copycat websites; author-editor nightmares; location information that is contradictory or missing; standards and identifiers missing, stolen or faked; false and fake bibliometrics; fake and unsuitable statements of indexing and presence in databases; amateurish website etc.

Shamseer et al (2017) analyzed 93 predatory journals, 99 OA, and 100 subscription-based journals (all with biomedical focus) and identified 13 proven characteristics by which predatory journals can be probably differentiated from acknowledged genuine journals. These characteristics are presented in the following table.

1. The scope of interest includes non-biomedical subjects alongside biomedical topics
2. The website contains spelling and grammar errors
3. Images are distorted/fuzzy, intended to look like something they are not, or which are unauthorized
4. The homepage language targets authors
5. The Index Copernicus Value is promoted on the website
6. Description of the manuscript handling process is lacking
7. Manuscripts are requested to be submitted via email
8. Rapid publication is promised
9. There is no retraction policy
10. Information on whether and how journal content will be digitally preserved is absent
11. The Article processing/publication charge is very low (e.g., < $150 USD)
12. Journals claiming to be open access either retain copyright of published research or fail to mention copyright
13. The contact email address is non-professional and non-journal affiliated (e.g., @gmail.com or @yahoo.com)

Table 1: Salient characteristics of potential predatory journals (Source: Shamseer et al. (2017: 11))

Also, based on the distinctive characteristics of prestigious and predatory journals, Rele, Kennedy and, Blas (2017) have developed a *Journal Evaluation Tool*. This tool provides a guide for each listed characteristic and also guides you on how to consider specific criteria when evaluating a certain journal. Each criterion is evaluated with scores and at the end, the total scores define whether the journal is a proper choice or not for publishing your work. It is worth noting that this tool is easily accessible and usable.[1]

Preston (2020) highlights that predatory publishers and journals often demand legitimacy because they perform peer review. Then the following question is raised: Who carries out peer review for predatory publishers and journals? To answer this question, according to Preston (2020), Publons has been cooperating with the Swiss National Science Foundation on a paper which purposes to examine whether there are patterns to reviewer characteristics for predatory journals, and how reviews for potentially predatory journals are globally distributed.

Hereupon, Severin et al. (2020: 2): 'matched 183,743 unique Publons reviews that were claimed by 19,598 reviewers.' The study results shed light that: '6,077 reviews were conducted for 1160 unique predatory journals (3.31% of all reviews). 177,666 were claimed for 6,403 legitimate journals (96.69% of all reviews). The vast majority of scholars either never or only occasionally submitted reviews for predatory journals to Publons (89.96% and 7.55% of all reviewers, respectively).'

Also, they found that developing regions have a larger share of reviews for predatory journals than developed regions. In addition, the characteristics of scholars who perform the review for potentially predatory journals are similar to those of authors who publish their work in these outlets.

Bohannon's experiment

A journalist John Bohannon conducted a sting operation to 304 OA publishers. Out of the total, 167 journals were selected from the DOAJ, 121 journals from Beall's list, and the last 16 were taken from both of them. He submitted a bogus medical paper which was accepted by 157 journals and rejected by 98. According to him, from the remaining 49 journals, 29 of them were abandoned by their creators, while the last 20 had communicated by e-mail saying that the manuscript is still in the process of review.

Bohannon (2013: 61) highlighted that 'the location of a journal's publisher, editor, and bank account are often continents apart. Acceptance was the norm, not the exception. The paper was accepted by journals hosted by industry titans Sage and Elsevier. The paper was accepted by journals published by prestigious academic institutions such as Kobe University in Japan. It was accepted by scholarly society journals. It was even accepted by journals for which the paper's topic was utterly inappropriate.' Furthermore, Bohannon (2013) was very surprised that 45% of the publishers listed in DOAJ that completed the review process of the paper, accepted it.

At the end of 2013, as a reaction to the "Sting," the Open Access Scholarly Publishers Association (OASPA) developed its "*Principles of Transparency and Best Practice in Scholarly Publishing*" in cooperation with other crucial players[2] to support best practices (Berger, 2017).

MATERIALS AND METHODS

This paper is mainly based on the literature review. In line with Fink (2013), the literature review is designed to provide an overview of the resources you analyze while researching a particular topic. More concretely, an integrative review was used as the main review method. Furthermore, Whittemore and Knafl (2005: 547) define the integrative review as 'the broadest type of research review methods allowing for the simultaneous inclusion of experimental and non-experimental research in order to more fully understand a phenomenon of concern. Integrative reviews may also combine data from the theoretical as well as empirical literature. In addition, integrative reviews incorporate a wide range of purposes: to define concepts, to review theories, to review evidence, and to analyse methodological issues of a particular topic.'

The review includes 28 scientific articles on predatory publishers and journals. We searched DOAJ and Google Scholar with the terms *predatory publisher* and *predatory journal*. Selected articles for analysis belong to the period 2013-2018. Thus, to investigate the ways of identifying predatory journals, we have used relevant literature published mainly recently. Based on it, we have presented the main findings in the form of lists, methods, and tools, which are valid in the academic circles and easily accessible form new researchers. Also, we have developed a guiding algorithm for evaluating publishers and journals.

RESULTS

Academics that mainly carry out their scientific activity outside the main industrial states are faced with tough dilemmas for choosing journals to publish. The acceptance of their manuscripts by world-renowned journals is not frequent, and this is due to the different linguistic aspects, then the content of the manuscripts, since they often deal with specific issues of their country. This puts them in an unfavorable position compared to researchers in developed countries. At the same time, they face a lot of pressure to publish in "international journals". As a result of this pressure, the phenomenon of OA predatory publishers trying to look like international scientific journals has recently emerged. In most cases, they lack the peer-review process. These journals always require authors to pay for publication (Björk, 2017). Rightly Kurt (2018) points out that there is a great need to raise awareness about the importance of selecting the right journals for publication, especially for young researchers in developing countries who are in the early stages of building their academic careers.

Jalalian and Dadkhah (2015: 82) think that 'developing a list of

1 This tool can be downloaded from the following link: https://digitalcommons.lmu.edu/librarian_pubs/40/.

2 DOAJ, the Committee on Publication Ethics (COPE), and the World Association of Medical Editors. These organizations, along with the Scholarly Publishing and Academic Resources Coalition (SPARC) and its partner affiliates, continue to provide critically-needed guidance and resources.

"GOOD JOURNALS" is a far better and more effective way to achieve that goal than publishing lists of "BAD JOURNALS" (That refers to the questionable journals), "HIJACKED JOURNALS" (that refers to the legitimate journals that their online identity is stolen by cybercriminals), and "FAKE PUBLISHERS" (that refers to the publishers of journals that are not registered officially by real persons or companies). Developing lists of quality journals and evaluating the quality of the academic journals on each of the main aspects of scientific publishing, such as the editorial workflow, peer-review process, data quality, readability, searchability, accessibility, and other aspects, is our current concern and the topic of our research.'

There are several lists, methods, and tools to identify legitimate publishers and journals as well as vice versa. In the following we will examine and discuss the main black and whitelists, proceeding further with other methods.

Blacklists

According to Beall (2013), a blacklist is easier to compose and keep than a whitelisted one. Also, it has more up-to-date information than a whitelist.

Beall's list

With the rise of open access and the movement to publish articles only online, the number of publishers and journals using the open-access model also increased (Richtig et al, 2018). This drastic increase was also noted by Jeffrey Beall, a librarian, and researcher at the University of Colorado, Denver. It was 2008, and Beall began to notice an influx of emails from new journals, asking him to send articles or join their editorial boards (Butler, 2013). In response to this phenomenon, he decided to devote himself to these ghosts and after a period of effort and work he created a list of predatory publishers and journals, which today is known as the Beall's list.

Quek and Teo (2018) mentioned that in 2010, Beall published his first list of 'potential, possible, or probable predatory scholarly open-access publishers.' He published the journals' evaluation criteria two years later. In the meantime, he published other works on the subject. In January 2017 because of legal pressure (Umlauf and Mochizuki, 2018), Beall deleted the list of potential predatory publishers from his blog.

Beall's articles have been widely criticized, including evaluation bias criteria and the lack of direct contact with publishers, to better understand their processes before blacklisting them (Quek and Teo 2018). However, there is an archived version of the Beall's list at webpage https://archive.fo/6EByy. The list contains 1,162 predatory publishers and 1,310 standalone journals. Beall's list of criteria includes five main issues: '*editor and staff, business management, integrity, poor journal standards/practices and other*.'

Despite the critics, Beall's list is the most known blacklist and also most used and discussed among academics (Bohannon, 2013; Butler, 2013; Xia, 2015; Xia et al, 2015; Shen and Björk, 2015; Danevska et al, 2016; Memon, 2016; Wallance and Perri, 2018; Björk, 2017; Bagues, Sylos-Labini and Zinovyeva, 2017; Laine and Winker, 2017; Berger, 2017; Frandsen, 2017; Kurt, 2018; Ritching et al, 2018; Quek and Teo, 2018; Umlauf and Mochizuki, 2018; Strielkowski, 2018).

As Umlauf and Mochizuki (2018) point out, Beall's criteria for completing these lists were not research-based but they were based on library science standards.

Bagues et al (2017) investigated the degree of publications of Italian authors in "*predatory*" journals and their motivations. They found that in 2012, the last year in their sample, about 5% of all papers by Italian economists and management academics in journals (English-language) were published in predatory journals (6,000 out of 1.8 million publications). Wallace and Perri (2018) examined the degree of publications in economics predatory journals. They analyzed the articles from selected data for authors from ninety different countries, although it turned out that only eight countries accounted for almost 50% of the articles and authors. They used Beall's lists to identify predatory journals and publishers included in the Research Papers in Economics archives (RePEc) and found that a huge number of researchers who are in the RePEc top 5%, have also published in predatory journals in 2015.

It should also be noted that the results of Bohannon (2013) point out that Beall has been successful in identifying poor quality publishers, as 82% of publishers on its list who completed the review process accepted the bogus paper.

Cabell's blacklist

Cabell's blacklist emerged in 2017 when the Beall's blog was closed. This list is presented by its creators, Cabell's, the scholarly analytics company from Beaumont, Texas, as the "*the only blacklist of deceptive and predatory academic journals*." Today, this list contains more than 4,000 regular journals and many more under review (Strielkowski, 2018).

Beall's List was accessible free of charge, and everybody could consult it any time. Meanwhile, Cabell demands enormous payments for their blacklist. As stated by Cabell's, 'the 1-year subscription to its Blacklist can be purchased for a $1500 add-on cost with the purchase of at least 1 more discipline on the Whitelist (ranging from $1000 to $3600 for 1 set).' Regrettably, Cabell's list does not allow authors to check their profiles for free as they can in Scopus (Strielkowski, 2018).

Whitelists

Academics have sought a credible whitelist to identify legitimate academic journals as an alternative to the blacklist (Umlauf and Mochizuki, 2018). Indeed, white lists have existed much earlier than blacklists. The most popular whitelists are available in the Web of Science (WoS) and Scopus databases. Also, several other databases are considered relatively reliable such as DOAJ, EBSCOhost etc. There are other databases that archive academic papers from various world-wide journals. Of these, some are closely related to a certain scientific field. In the following, we will discuss some of the most credible and highly appreciated databases in the academic world.

According to the official website, **Web of Science** is 'the world's leading citation database, with multidisciplinary information from over 18,000 high impact journals, over 180,000 conference proceedings, and over 80,000 books from around the world. With over 100 years of comprehensive coverage and more than one billion cited reference connections, you can search with confidence and explore the complete network of citations underpinning the significant research in any field' (Web of Science, 2018). It is managed by Clarivate Analytics.

In addition to many other products available, Web of Science provides for free *The Master Journal List* which includes all journal titles covered in it and it is updated bi-monthly (six times a year).

This list is considered a whitelist, so it should be the first whitelist taken into consideration by researchers and scholars to select journals for publication. It is worth noting that besides the possibility of downloading it, there is also the option of online search to see if a certain journal is indexed or not in the Web of Science. This search can be done by writing the full name of the journal (without errors) or the ISSN number (print or online).

Scopus is considered the second database at world level, i.e. after the Web of Science. Although on their official website it is presented as 'the largest abstract and citation database of peer-reviewed literature: scientific journals, books and, conference proceedings.' It is a registered trademark of Elsevier Company and dates back to 1970. It has over 5,000 publishers, 22,800 serial titles, and 150,000 books and has about 1.4 billion cited references from the early start (Scopus, 2018b).

Scopus also has a database that includes indexed journal titles, but to access it easily you need to be registered with Scopus. In addition, Elsevier offers access for free to the updated Scopus list on the official website, which is an Excel workbook, but usually, you cannot find it easily. This list can be accessed through the following link: https://www.elsevier.com/solutions/scopus/how-scopus-works/content. As well, Scopus always updates the list of journal titles that have been removed from its database for various reasons and this list can be found in the same place.

We have analyzed the second list, that is, with the titles removed in order to find the reason why such titles have been removed. This list currently contains 424 titles. Of these, 289 (about 68%) have been removed due to publication concerns, 114 (about 27%) have been removed because they did not meet any of Scopus set metrics and benchmarks. The remaining of 21 (about 5%) are identified by the so-called "*radar*" tool, which means that they have undergone rapid unexplained changes (Scopus, 2018a).

Since the predatory journals are on the rise, Scopus has taken rigorous measures and is constantly re-evaluating the titles listed to ensure titles continue to meet high-quality standards. Each year, about 3,500 new titles are proposed to be added in Scopus, but roughly 33% of these titles fulfil the minimum criteria (Scopus, 2018a). Therefore, they suggest that in addition to their whitelist, the list of removed titles should also be checked.

The Directory of Open Access Journals (DOAJ) was established 10 years ago by a library scientist at Lund University in Sweden, known as Lars Bjørnshauge (Bohannon, 2013). This list continues to be the most important whitelist (Berger, 2017). The DOAJ started with 300 open access journals and today contains 12,152 OA journals including all fields of science as technology, medicine, social science, and humanities from 128 countries across the world.

Laine and Winker (2017) emphasize that DOAJ is not an all-inclusive list of all genuine OA journals. If a journal is not listed on it, it should not be supposed that it is illegitimate or fictitious. It could be a journal that has not made a request to be included in DOAJ or there is not enough allocated fund to fulfil all of its conditions. Contrariwise, joining DOAJ does not assure great value - DOAJ has a standard tool for its users, it seeks to warn them if they see a journal with doubtful practices on its list.

According to Berger (2017: 208), 'the most significant result of the **sting** was that DOAJ, which continues to be the most important whitelist, required all its listed journals to reapply using a rigorous vetting system. As of December 2016, DOAJ accepted 3,700 journals, rejected 6,500 applications… removed 1,450 journals and delisted 2,850 journals for not re-applying to stay indexed.'

Memon (2016) sheds light that articles published in predatory journals are likewise apparent on ResearchGate as that of trustworthy journals. According to him, ResearchGate probably does not control or filter the content of the papers uploaded. Maybe, this is the reason why we encounter articles from predatory journals on ResearchGate.

"Think. Check. Submit" approach

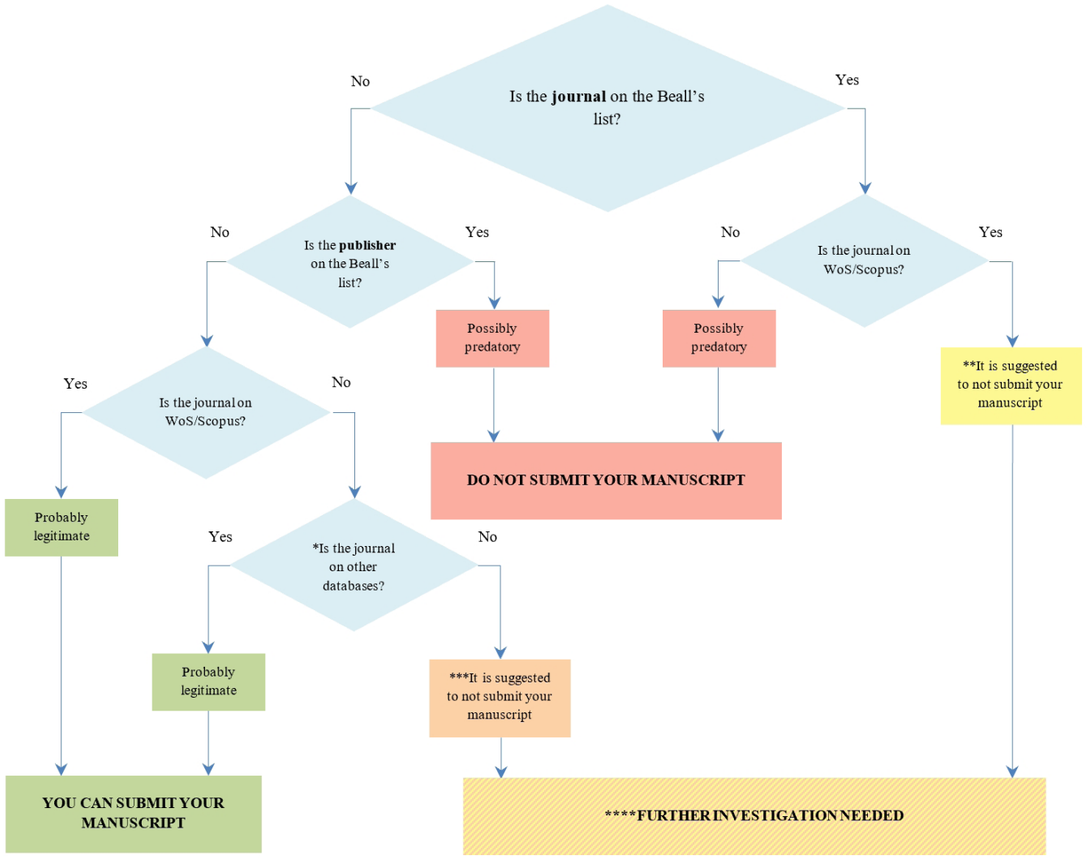
As cited by Forrester, Björk and Tenopir (2017: 281), 'many studies over the last two decades have examined that decision process, and it is a complex array of competing criteria, including, among other factors, time from submission to publication, acceptance/rejection rate, potential audience, fees, impact factor, and perceptions of prestige' (Björk and Holmström, 2006; Björk and Öörni, 2009; Coonin and Younce, 2010; Jamali et al, 2014; Mabe, 2009; Mabe and Amin, 2002; Mabe and Mulligan, 2011; Rowlands and Nicholas, 2005; Tenopir et al, 2011, 2016).'

On the other hand, although there are many debates and discussions in academic circles regarding predatory publishers, the evidence is obvious that they exist in the academic world and is a thriving business. Therefore, we need to be very careful when accepting invitations to publish in various journals and not to get excited without casting a second glance at the invitation source (Quek and Teo, 2018). Kurt (2018) points out that the pressure to publish often causes researchers to fall prey to advertising used by predatory journals because they do not analyze the quality of the journal at all before sending the manuscript for publishing.

According to the official website, "**Think. Check. Submit**." is 'a campaign to help researchers to identify trusted journals for their research. It is a simple checklist that researchers can use to assess the credentials of a journal or publisher. The campaign has been produced

with the support of a coalition from across scholarly communications[3] in response to discussions about deceptive publishing.'
The key questions of this approach include (Think, Check, Submit, 2018):

THINK	Are you submitting your research to a trusted journal? Is it the right journal for your work?
CHECK	Use this check list to assess the journal (there are several questions, visit the following website: http://thinkchecksubmit.org/check/).
SUBMIT	Only if you can answer 'yes' to the questions on our check list.



** With other databases, we mean all other reliable academic databases.*

*** Since the predatory journals are on the rise, Scopus has taken rigorous measures and is constantly re-evaluating the titles listed to ensure titles continue to meet high quality standards. Thus, if a journal is on the Beall's list and the same is on WoS/Scopus, it is suggested not to submit the manuscript since such journal in the near future may be removed by them.*

**** If a journal is not on WoS/Scopus or in any other reliable academic databases, it is suggested not to submit the manuscript.*

***** It is recommended to visit websites of journals and analyze them according to the characteristics given by many authors on predatory journals/publishers. This review should also include analyzing the published papers in these journals. The more such features are present, the more you should hesitate to submit the manuscript for publication.*

Figure 1: Predatory journals evaluation algorithm

3 Association of Learned & Professional Society Publishers (ALPSP), BioMed Central, Committee on Publication Ethics (COPE), Directory of Open Access Journals (DOAJ), ISSN International Centre, Ligue des Bibliothèques Européennes de Recherche – Association of European Research Libraries (LIBER), Open Access Scholarly Publishers Association (OASPA), Springer Nature, International Association of STM Publishers (STM), Ubiquity Press

We have developed a guiding algorithm for evaluating publishers and journals based on our experience. Since the practice has proved that despite attempts not to fall into the trap set up by these predatory publishers and journals, often young researchers inadvertently found themselves part of them.
As mentioned earlier, the most popular whitelists are available in the Web of Science and Scopus databases. The Web of Science database should be the first whitelist taken into consideration by researchers and scholars to select journals for publication, followed by Scopus.

DISCUSSION

Predatory journals are a blight on science, and something needs to be done to curtail these unethical publishers (Clark, 2018). Their number has increased rapidly in the last five years however, it is difficult to measure. Some studies confirm that the country's regional distribution of publication and authorship is highly skewed and lead by Asian and African researchers (Frandsen, 2017). Whereas, Kurt (2018) think that numerous scholars from developing countries have the impression that western journals will reject them and so they seek alternative journals for publication. Severin et al (2020: 10) discuss that: 'inexperienced scholars and scholars in developing countries might be more likely to be tricked into believing that they review for a legitimate journal. It is also possible that predatory journals provide an opportunity for marginalized members of the global academic community to survive in the "publish or perish" culture of today's academia.'
As we have seen, the "*academic pollution*" has affected a number of prestigious institutions. Clark (2018) considers that even the most prestigious institutions in the world have been affected, although the cases are few, 9 articles from Harvard University and 11 from Mayo Clinic. Bohannon (2013) found that 45% of the publishers listed in DOAJ that completed the bogus paper' review process, have accepted it. Fortunately, the "*Bohannon Sting*" operation resulted in certain noteworthy changes (Berger, 2017). Wallance and Perri (2018) found that in 2015 an unexpected number of scholars who are in the top 5% in RePEc, have also published in predatory journals.
Beall had only scientific journals as an initial focus. But the same strategies of predatory publishers are being used to organize fake conferences, to deceive academics, to hijack legitimate journals' websites, to offer low-quality science without proper academic values, and to give space to unethical authors. Consequently, these cybercriminals are misusing the necessity of academics and researchers to publish their work. Also, they are getting rich because many dishonorable authors are willing to pay to publish low-quality manuscripts for the purpose of professional advancement (Umlauf and Mochizuki, 2018).
As stated by Richtig et al. (2018: 3), 'Although Beall's list had certain shortcomings, it represented a valuable tool that researchers could use to assess journals on the basis of their credibility, raised awareness about this important issue and provided guidance for other institutions to create their own blacklists.'
Academics involved in the staff advancement process should warn and advise young researchers on where to submit their manuscripts for publication. Review committees for academic advancement should also be prepared to conduct a serious evaluation of articles published in predatory or captured journals (Danevska et al, 2016). As well as bibliographic databases should have a vigorous role in reinforcing the quality control of indexed articles/journals (Frandsen, 2017).
Therefore, the identification of these journals is very important for authors, researchers, reviewers, and editors, because scientific work that does not go through the proper review process should not be included in the register of scientific data (Laine and Winker, 2017). Richtig et al (2018) propose that a new system would have to be implemented to identify predatory journals.
Rightly Strielkowski (2018) raises the concern that there is no clear recommendation as to what to do with journals that Beall suspected of having fraudulent practices that are indexed in respected databases such as Web of Science and Scopus. Should the researchers continue to publish on them or should they seek other blacklists and guidelines from ethics commissions for publication? If so, who would select such commissions, or who will determine which journals are good and which ones are bad?
According to Memon (2016: 1645), 'ResearchGate has been lenient in its policies and has created a space for predatory journals to enter the website. Some of the journals displaying fake impact factor on their website (previously mentioned) are available in ResearchGate with an impact factor - a misleading point for scientists who rely on ResarchGate.' He also points out (Memon, 2016: 1647) that 'ResearchGate should take a serious note of the fact that considerations given to ghost journals and putting them in the row of reliable and quality journals might create an alarming situation in future. This dark side of academic writing should be hampered, before it finds more space and prevails, as it would not only affect the scientists only but also the community as a whole.'
Beall (2016) has proposed some policy changes as follows: the use of the quantity of articles published as a measure of academic performance should be prohibited by universities and colleges, researchers and esteemed journals should not quote articles from predatory journals and academic library databases should reject metadata for such publications; organizations that provide publishers with services, including those that license journal management software or provide standard identifiers, should refuse to work with predatory publishers, academic databases such as Scopus and Thomson Reuters need to raise the bar for acceptance, removing journals and publishers that use false peer-review practices.

CONCLUSION

This paper aims to provide information on recognizing and avoiding publishing in predatory journals. We have consulted the recent literature and practices of different countries, and we have summarized the most used tools/methods to identify predatory publishers and journals. In addition, we have developed a guiding algorithm for evaluating journals/publishers.
This study contributes to the provision of information on identifying and avoiding publishing in predatory journals.

Thus, it may be of particular interest to the countries that face the same academic problems. There are a number of other potential areas for future research that can provide increased scientific value. Thus, it is recommended that the following limitations be taken into account in future research.

This paper is mainly based on the literature review. In the future, the empirical aspect should be included as well. Hence, the rate of publications in predatory journals should also be researched. Besides this, the reasons and motives of publication in these journals should be examined.

REFERENCES

Bagues, M., Sylos-Labini, M. and Zinovyeva, N. (2018) 'A walk on the wild side:'Predatory' journals and information asymmetries in scientific evaluations', *Research Policy*, [Online], Available: http://hdl.handle.net/10419/171025 [11 May 2020].

Beall, J. (2010). "Predatory" open-access scholarly publishers. *The Charleston Advisor*, Vol. 11, No. 4, pp. 10-17.

Beall, J. (2013) 'Predatory publishing is just one of the consequences of gold open access', *Learned Publishing,* Vol. 26, No. 2, pp.79-84. https://doi.org/10.1087/20130203

Beall, J. (2016) 'Ban predators from the scientific record', *Nature*, Vol. 534, No. 7607, pp. 326-327. https://doi.org/10.1038/534326a

Berger, M. (2017) 'Everything you ever wanted to know about predatory publishing but were afraid to ask', *ACRL 2017 Conference*, Baltimore, Maryland, pp. 206-217.

Björk, B.C. (2017) 'Journal portals–an important infrastructure for non-commercial scholarly open access publishing', *Online Information Review*, Vol. 41, No. 5, pp. 643-654. https://doi.org/10.1108/OIR-03-2016-0088

Bohannon, J. (2013) 'Who's afraid of peer review?', *Science*, Vol. 342, No. 6154, pp. 60-65. https://doi.org/10.1126/science.342.6154.60

Bolick, J., Emmett, A., Greenberg, M. L., Rosenblum, B., and Peterson, A. T. (2017) 'How open access is crucial to the future of science', *The Journal of Wildlife Management*, Vol. 81, No. 4, pp. 564-566. https://doi.org/10.1002/jwmg.21216

Butler, D. (2013) 'The dark side of publishing', *Nature*, Vol. 495, No. 7442, pp. 433-435. https://doi.org/10.1038/495433a

Clark, J. (2018) 'Letter to the editor-predatory journals: Bad for all but especially authors from low and middle income countries', *Acta Medica Portuguesa*, Vol. 31, No. 3, pp. 184-185. https://doi.org/10.20344/amp.10489

Danevska, L., Spiroski, M., Donev, D., Pop-Jordanova, N., and Polenakovic, M. (2016) 'How to recognize and avoid potential, possible, or probable predatory open-access publishers, standalone, and hijacked journals', *Prilozi*, Vol. 37, No. 2-3, pp. 5-13. https://doi.org/10.1515/prilozi-2016-0011

Fink, A. (2013) *Conducting research literature reviews: From the Internet to paper*, Thousand Oaks: Sage Publications.

Forrester, A., Björk, B. C., and Tenopir, C. (2017) 'New web services that help authors choose journals', *Learned Publishing*, Vol. 30, No. 4, pp. 281-287. https://doi.org/10.1002/leap.1112

Frandsen, T. F. (2017) 'Are predatory journals undermining the credibility of science? A bibliometric analysis of citers', *Scientometrics*, Vol. 113, No. 3, pp. 1513-1528. https://doi.org/10.1007/s11192-017-2520-x

Jalalian, M., and Dadkhah, M. (2015) 'The full story of 90 hijacked journals from August 2011 to June 2015', *Geographica Pannonica* Vol. 19, No. 2, pp. 73-87. https://doi.org/10.18421/GP19.02-06

Kozak, M., and Hartley, J. (2013) 'Publication fees for open access journals: Different disciplines-different methods', *Journal of the American Society for Information Science and Technology*, Vol. 64, No. 12, pp. 2591-2594. http://dx.doi.org/10.1002/asi.22972

Kurt, S. (2018) 'Why do authors publish in predatory journals?', *Learned Publishing*, Vol. 31, No. 2, pp. 141-147. https://doi.org/10.1002/leap.1150

Laine, C., and Winker, M. A. (2017) 'Identifying predatory or pseudo-journals', *Biochemia Medica*, Vol. 27, No. 2, pp. 285-291. https://doi.org/10.11613/BM.2017.031

Memon, A. R. (2016) 'ResearchGate is no longer reliable: leniency towards ghost journals may decrease its impact on the scientific community', *Journal of Pakistan Medical Association*, Vol. 66, No. 12, pp. 1643-1647.

Quek, H. C., and Teo, E. K. (2018) 'Predatory publishing; pressures, promotions and perils', *Proceedings of Singapore Healthcare*, Vol. 27, No. 1, pp. 3-5. https://doi.org/10.1177/2010105817749602

Preston, A. (2020) 'Solving the Mystery of Peer Review for Predatory Journals', [Online], Available: https://clarivate.com/webofsciencegroup/article/solving-the-mystery-of-peer-review-for-predatory-journals/ [4 July 2020].

Rele, Sh., Kennedy, M., and Blas, N. (2017), *Journal Evaluation Tool*. LMU Librarian Publications & Presentations, [Online], Available: http://digitalcommons.lmu.edu/librarian_pubs/40 [10 Jun 2020].

Richtig, G., Berger, M., Lange-Asschenfeldt, B., Aberer, W., and Richtig, E. (2018) 'Problems and challenges of predatory journals', *Journal of the European Academy of Dermatology and Venereology*, Vol. 32, No. 9, pp. 1-9. https://doi.org/10.1111/jdv.15039

Scopus (2018a) *The Scopus solution to predatory journals,* [Online], Available: https://conf.neicon.ru/materials/28-Sem0417/170417_0930_Steiginga.pdf [27 Sep 2018].

Scopus (2018b), [Online], Available: https://www.scopus.com/ [27 Sep 2018].

Severin, A., Strinzel, M., Egger, M., Domingo, M., and Barros, T. F. (2020) 'Who reviews for predatory journals? A study on reviewer characteristics.' *BioRxiv*. [Online], Available: https://www.biorxiv.org/content/biorxiv/early/2020/03/11/2020.03.09.983155.full.pdf [5 July 2020].

Shamseer, L., Moher, D., Maduekwe, O., Turner, L., Barbour, V., Burch, R., Clark, J., Galipeau, J., Roberts, J. and Shea, B.J. (2017) 'Potential predatory and legitimate biomedical journals: can you tell the difference? A cross-sectional comparison', *BMC Medicine*, Vol. 15, No. 1, 28. https://doi.org/10.1186/s12916-017-0785-9

Shen, C., and Björk, B. C. (2015), 'Predatory'open access: a longitudinal study of article volumes and market characteristics' *BMC Medicine* Vol. 13, No. 1, pp. 1-15. https://doi.org/10.1186/s12916-015-0469-2

Strielkowski, W. (2018) 'Setting new publishing standards after the Beall's list', *The International Journal of Occupational and Environmental Medicine,* Vol. 9, No. 2, pp. 108-110. https://doi.org/10.15171/ijoem.2018.1314

The Directory of Open Access Journals (2018), [Online], Available: https://doaj.org [24 Sep 2018].

Think. Check. Submit (2018), [Online], Available: http://thinkchecksubmit.org/ [23 Sep 2018].

Umlauf, M. G., and Mochizuki, Y. (2018) 'Predatory publishing and cybercrime targeting academics', *International Journal of Nursing Practice*, Vol. 24, No. S1, pp. 1-7. https://doi.org/10.1111/ijn.12656

Wallace, F. H., and Perri, T. J. (2018), 'Economists behaving badly: publications in predatory journals', *Scientometrics* Vol. 115, No. 2, pp. 749-766. https://doi.org/10.1007/s11192-018-2690-1

Web of Science (2018), [Online], Available: https://clarivate.com/products/web-of-science/ [27 Sep 2018].

Whittemore, R., and Knafl, K. (2005) 'The integrative review: Updated methodology', *Journal of Advanced Nursing*, Vol. 52, No. 5, pp. 546-553. https://doi.org/10.1111/j.1365-2648.2005.03621.x

Xia, J. (2015) 'Predatory journals and their article publishing charges' *Learned Publishing*, Vol. 28, No. 1, pp. 69-74. https://doi.org/10.1087/20150111

Xia, J., Harmon, J. L., Connolly, K. G., Donnelly, R. M., Anderson, M. R., and Howard, H. A. (2015) 'Who publishes in "predatory" journals?' *Journal of the Association for Information Science and Technology*, Vol. 66, No. 7, pp. 1406-1417. http://doi.org/10.1002/asi.23265