

DOI: 10.46943/XI.CONEDU.2025.GT19.059

DATA ENVELOPMENT ANALYSIS (DEA) EM ESTUDOS SOBRE EDUCAÇÃO: UMA ANÁLISE SISTEMÁTICA

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RESUMO

A relevância da educação para a sociedade é indiscutível, uma vez que a maior parte dos sistemas educacionais no mundo é financiada por recursos públicos, o que torna crucial sua oferta da forma mais eficiente possível (Johnes; Johnes, 1995). Quanto mais austeras estiverem as condições econômicas de um país, mais premente é a questão do gerenciamento eficiente do sistema educacional. Assim, a mensuração da eficiência nas instituições de ensino é alvo de diversos debates. Dessa forma este artigo tem como objetivo a análise dos temas Data Envelopment Analysis (DEA), educação e universidades. Uma grande quantidade de métodos é utilizada na literatura para estudar a eficiência na educação superior (Witte; López-Torres, 2017; Guccio; Martorana; Mazza, 2017). Entre esses métodos, a Data Envelopment Analysis (DEA) emerge como um dos mais aplicados, por considerar a natureza multiproducto das atividades dessas instituições (Agassisti; Bianco, 2009). Para tanto, o

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método deste estudo classifica-se como uma abordagem quantitativa e qualitativa a partir de uma amostra não probabilística intencional de 167 artigos utilizando as bases de dados Scopus e Web of Science no período de 1990 a 2021. Em seguida, realizou-se uma observação direta com dados primários e indicadores bibliométricos com uso de softwares computacionais para estabelecer rede de autorias, citações, periódicos e fases evolutivas dos conceitos. A análise cronológica dos artigos, permitiu identificar três fases: os estudos iniciais em DEA e educação, a fase de disseminação global e publicações combinadas e a terceira, estudos de consolidação.

Palavras-chave: Data Envelopment Analysis (DEA), Educação, Universidades.

INTRODUÇÃO

A relevância da educação para a sociedade é indiscutível. A maior parte dos sistemas educacionais no mundo é financiada por recursos públicos, o que torna crucial sua oferta da forma mais eficiente possível (JOHNES; JOHNES, 1995). Assim, a mensuração da eficiência nas instituições de ensino é alvo de diversos debates (WITTE; LÓPEZ-TORRES, 2017). Quanto mais austeras estiverem as condições econômicas de um determinado país, mais premente é a questão do gerenciamento eficiente do sistema educacional (WITTE; LÓPEZ-TORRES, 2017).

Dessa forma, uma grande quantidade de métodos é utilizada na literatura para estudar a eficiência na educação superior (WITTE; LÓPEZ-TORRES, 2017; GUCCIO; MARTORANA; MAZZA, 2017). Entre esses métodos, Data Envelopment Analysis (DEA) emerge como um dos mais aplicados, por considerar a natureza multiproduto das atividades dessas instituições (AGASSISTI; BIANCO, 2009).

As Instituições de Ensino Superior (IES) possuem como limitação a quantidade de recursos e a obrigatoriedade de alcance de resultados a fim de prestar uma educação de qualidade. Nessa acepção, a DEA valida-se como a ferramenta mais adequada para observar a relação entre os recursos e resultados, já que permite mensurar a eficiência das instituições, fornece ferramentas e insights valiosos aos gestores, na priorização de esforços nos pontos de menor desempenho (MIRANDA; RODRIGUES, 2010).

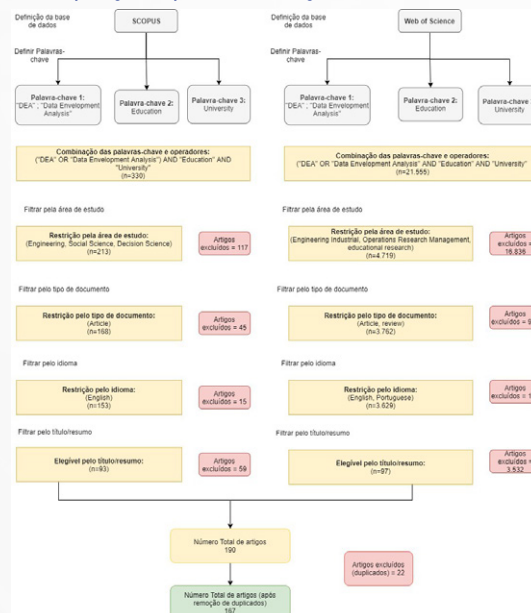
Portanto, este trabalho objetiva mapear a produção acadêmica sobre DEA e seus usos na educação superior, no período de 1990 a 2021, utilizando a análise bibliométrica para apresentar o uso desse método no contexto educacional.

MÉTODO DE PESQUISA

A sistematização da pesquisa científica é um procedimento formal que confere ao trabalho robustez e veracidade, além de permitir a reprodutibilidade do método (TRANFIELD et al., 2003). Em conformidade ao exposto e para alcance do objetivo supracitado, foram definidos os descritores das temáticas, divididos em três categorias: Data Envelopment Analysis (DEA), Educação e Universidades.

Para a obtenção das informações, foram utilizadas as técnicas de coleta de pesquisa bibliométrica. Os artigos foram lidos e as variáveis extraídas da leitura foram autores e coautores, título do artigo, título do periódico, palavras-chave, data de publicação, número de páginas e quantidade de citações. Posteriormente, com a seleção efetuada conforme critérios de inclusão e exclusão foram selecionados 190 artigos. Com a exclusão dos duplicados, a amostra para análise contém 167 publicações. A figura 1 ilustra o procedimento adotado.

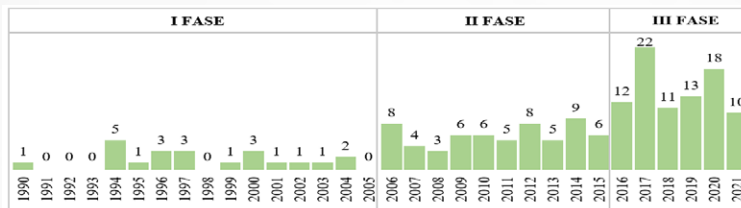
Figura 1 - Step-by-step da definição da amostra da pesquisa



RESULTADOS E DISCUSSÃO

A sistematização das informações permitiu construir a **análise da cronológica das publicações** – ilustrado na Figura 2. Com os dados quantitativos, percebe-se de forma clara o comportamento das publicações. Em virtude disso são propostas em três fases de exploração do tema.

Figura 2 - Evolução temporal dos artigos



A **primeira fase** contém 21 trabalhos práticos e o trabalho teórico de Molinero (1996) que explora as contribuições de Beasley (1990) com uso de dados de uma amostra de 4 artigos. A análise de conteúdo possibilita informar que até o ano 2000 todas as publicações estudavam dados da Inglaterra, Estados Unidos, Canadá ou Israel. De 2000 a 2005 há uma expansão com aplicação da DEA na Finlândia, Austrália, Taiwan e África do Sul.

As vertentes literárias práticas exploradas neste intervalo são: comparação do desempenho de departamentos universitários (BEASLEY, 1990; SINUANY-STERN; MEHREZ; BARBOY, 1994; ARCELUS; COLEMAN, 1996; KORHONEN; TAINIO; WALLENIUS, 2000), DEA como apoio à gestão departamental (JOHNES; JOHNES, 1995; SARRICO et al., 1997), eficiência de programas de graduação (SARRICO; DYSON, 2000) e pós-graduação (THANASSOULIS, 1996; COLBERT; LEVARY;

SHANER, 2000), desempenho de universidades (SARRICO; DYSON, 2000; TAYLOR; HARRIS, 2004; LIU; LEE; TZENG, 2004) problemas de avaliação na educação superior (DOYLE; GREEN, 1994).

Outrossim, existem trabalhos que avaliam a performance do sistema educacional de uma nação (BREU; RAAB, 1994; GROSSKOPF et al., 1999; ABBOTT; DOUCOULIAGOS, 2003) e a performance de escolas (THANAS-

SOULIS; DUNSTAN, 1994), problemas da escola básica como o viés político (THANASSOULIS, 1996) e ineficiência (FUKUYAMA; WEBER, 2002).

Na **segunda fase**, de 2006 a 2015, as pesquisas na área DEA em educação triplicaram, em abrangência geográfica e número de publicações. Esse estágio evolutivo representa a disseminação de pesquisas em outros países, além de estudos em mais de um nível educacional. As temáticas abordadas na educação superior abordam a avaliação e/ou desempenho das universidades, departamentos, temáticas que permeiam o ambiente acadêmico e a análise simultânea de DEA e outras técnicas de mensuração de eficiência.

A escola básica é trabalhada associada com DEA como análise das diferenças entre escolas públicas e privadas (MANCEBON; MUNIZ, 2008) com abordagem não paramétrica (CHERCHYE et al., 2010). Ou ainda, uma análise preliminar da eficiência das escolas da Austrália (BLACKBURN; BRENNAN; RUGGIERO, 2014).

As publicações com temática na educação superior abordam inicialmente a análise envoltória de dados com uma comparação da ferramenta da eficiência das universidades com um ranking vigente no país (BOUGNOL; DULÁ, 2006). Os resultados convergem corroborando a aplicabilidade da DEA. A grande maioria dos trabalhos analisam de eficiência entre universidades (JOHNES, 2006; FERNANDO; CABANDA, 2007; CHANG et al., 2009; CELIK; ECER, 2009; AGASISTI; JOHNES, 2009; AGASISTI; DAL BIANCO, 2009; TYAGI; YADAV; SINGH, 2009; AGASISTI; DAL BIANCO, 2009; AGASISTI; PÉREZ-ESPARRELLS, 2010; ECKLES, 2010; KANTABUTRA; TANG, 2010; CHEN; CHEN, 2011; THANASSOULIS et al., 2011; BEI; DONGSHENG, 2012; MIRANDA; GRAMANI; ANDRADE, 2012; AGASISTI; POHL, 2012; SEXTON; COMUNALE; GARA, 2012; BAYRAKTAR; TATOGLU; BLIDISEL, 2013; ZAIM, 2013; CHANG; TSAI, 2013; TURNER, 2013; ALTAMIRANO-CORRO; PENICHE-VERA, 2014; AL KAHTANI; MALIK, 2014; HO et al., 2014; NKONKI; NTLABATHI; NCANYWA, 2014; KYRATZI; TSAMADIAS; GIOKAS, 2015; HO, 2015).

Resultados notórios da aplicação de DEA quanto à performance de universidades são de Agasisti e Salerno (2007) que observaram uma relação diretamente proporcional do tamanho da instituição com a eficiência. Outrossim, Ho et al., (2014) explicitam que as IES mais eficientes possuem melhores programas de transferência de conhecimento. Oportunidades de pesquisa com essa conclusão é analisar as variáveis exploradas, orientação do modelo e replicações do estudo.

No contexto da educação superior, a nível institucional, as pesquisas trabalham profundamente a eficiência entre os departamentos: temas como e a redução de custos (GIMENEZ; MARTINEZ, 2006; HE, 2015; CHANG; CHUNG; HSU, 2012), comparação entre departamentos (KOKSAL; NALCACI, 2006; FERNANDO; CABANDA, 2007; AGHA et al., 2011), avaliação departamental (MARTÍN, 2006), influência do tamanho na eficiência (LEITNER et al., 2007), organização e categorização (KAO; HUNG, 2008), análise da performance em três anos (AGASISTI et al., 2011; KOUNETAS et al., 2011) são explorados

Ademais, pesquisas abordam a aplicação de DEA nas instituições superiores sob uma miríade de abordagens: boas práticas administrativas (CASU; THANASSOULIS, 2006), influência das políticas educacionais na eficiência (GLASS et al., 2006; CHANG et al., 2009; MONTONERI et al., 2012; RUIZ; SEGURA; SIRVENT, 2015), impacto de reformas (AGASISTI; DAL BIANCO, 2009; KATHARAKI; KATHARAKIS, 2010).

A versatilidade e aplicabilidade da DEA na educação permite mensurar o desempenho de estudantes (JOHNES, 2006; VIERSTRAETE; YERGEAU, 2012; YALCIN; TAVSANCIL, 2014; DOWLATSHAHI, 2015), docentes (ORAL et al., 2011; LAURETI; SECONDI; BIGGERI, 2014), indicadores de qualidade (MURIAS et al., 2008), programas de ensino (NKONKI; NTLABATHI; NCANYWA, 2014) e a variação da transferência de tecnologia (ANDERSON; DAIM; LAVOIE, 2007).

A aplicabilidade da DEA na educação mostra-se relevante no estudo da mensuração da eficiência na área educacional. Ademais, os autores mensuram a eficiência pela combinação da técnica e outros métodos

como Analytic Hierarchy Process (AHP), Stochastic Frontier Analysis (SFA), Balanced ScoreCard (BSC) (KONGAR; PALLIS; SOBH, 2010) e Lógica Fuzzy (YANG; SHIEH; WU, 2014).

Alternativamente, o Analytic Hierarchy Process (AHP) mostra-se como método estudado concomitante com DEA. Bei e Dongsheng (2012) estudaram a performance de 15 docentes chineses; Altamirano-Corro e Peniche-Vera (2014) mensuraram a eficiência de 13 departamentos de uma universidade mexicana e Ho (2015) avaliou a eficiência de oito universidades ao redor do mundo com as técnicas AHP e DEA.

A Stochastic Frontier Analysis (SFA) também é uma técnica utilizada simultaneamente com DEA nas investigações científicas na busca de padrões de eficiência econômica de 75 universidades (AGASISTI; BIANCO, 2009); performance de cursos de 40 instituições (MIRANDA; GRAMANI; ANDRADE, 2012) e mensuração de eficiência relativa de práticas de gestão da qualidade de 22 instituições públicas e privadas (BAYRAKTAR; TATOGLU; ZAIM, 2013). Salienta-se que neste último trabalho os resultados demonstram que a depender da instituição (pública ou privada) o foco da eficiência são pontos distintos.

Na **terceira fase**, que compreende os anos de 2016 a 2021, abrange 86 artigos. Desses, apenas 5 são teóricos. O primeiro estudo teórico da última fase é o de Aleskerov, Belousova e Petrushchenko (2017), que sistematiza os resultados empíricos dos conceitos de eficiência aplicados a instituições de ensino superior russo, averiguação replicada na Inglaterra (MAYSTON, 2017), nos Estados Unidos (ZHANG; CHEN, 2018), no Marrocos (BOUTCHICH, 2020) e na Argentina (FERRO; DELIA, 2020).

No ano de 2016, houve grande destaque para publicações italianas, com estudos que analisaram a performance das universidades italianas e seus departamentos, cujos resultados sugeriram um aumento na eficiência das instituições, ocasionado por um incremento de performance nos departamentos de Engenharia e Ciências (GUCCIO; MARTORANA; MONACO, 2015; AGASISTI; WOLSZCZAK-DERLACZ, 2015; BARRA; ZOTTI, 2015).

Outras contribuições do período incluem: relações entre o treinamento de talentos e um aumento da eficiência (SHIKUI; CHUANYI; XIAOHONG, 2016), a expressão dos índices de eficiência através de DEA (MUNOZ, 2016; KUDŁA; STACHOWIAK-KUDŁA, 2016; JABLONSKY, 2015), a avaliação de departamentos (KARBASIAN; KHAYAMBASHI; TAVAKOLI, 2016) e estudantes (FUENTES; FUSTER; LILLO-BAÑULS, 2016; MUNOZ; QUEUPIL, 2016; LEE; WORTHINGTON, 2016; ALIP; JATI, 2016) a partir da ferramenta.

Em 2017, houve um crescimento na produção científica usando DEA, em que os trabalhos apresentaram aportes relevantes ao cenário científico. Os artigos do período ilustraram aplicações na estimativa de índices de eficiência em instituições (VISBAL-CADAVID; MARTÍNEZ-GÓMEZ; GUIJARRO, 2017; MIKUŁOVÁ, 2017; THANASSOULIS; DEY; PETRIDIS; GONIADIS; GEORGIU, 2017; GUCCIO; MARTORANA; MAZZA, 2017; ANDERSSON; ANTELIUS; MÅNSSON; SUND, 2016; SAGARRA; MAR-MOLINERO; AGASISTI, 2017; TRAN; VILLANO, 2016; PODINOVSKI; HUSAIN, 2015), alunos (CHEN; CHEN; OZTEKIN, 2016; PEROVIC; BOJANIC, 2017; MORADI; AMIRIPOUR, 2017), professores (WITTE; LÓPEZ-TORRES, 2017) e programas (KASHIM; KASIM; RAHMAN, 2018; SHARIFIAN; EBRAHIMI; ALIMOHAMMADLOU, 2017), com destaque para avaliações anuais com utilização de DEA (QIAO; SI, 2017; JOHNES; TONE, 2016).

No ano seguinte, ocorreu uma queda no número de publicações, com trabalhos avaliando a eficiência de estados (SINGH; RANJAN, 2017), Instituições de ensino superior (EXPÓSITO-GARCÍA; VELASCO-MORENTE, 2018; ZINKOVSKY; DERKACHEV, 2018; TRAN; VILLANO, 2015; KLUMPP, 2018), departamentos e alunos (GNEWUCH; WOHLRABE, 2018; LIN; LI; PAN, 2018).

Nos dois anos seguintes ocorreu um leve crescimento no número de publicações, representando um aumento no interesse sobre o tema. As publicações objetivaram, principalmente: sanar a falta de representatividade em análises de eficiência em universidades (MORENO-GÓMEZ; CALLEJA-BLANCO; MORENO-GÓMEZ, 2019; LIU; SONG; YANG, 2019;

HATAMI-MARBINI; TOLOO, 2019; GRALKA; WOHLRABE; BORNMANN, 2019; GÜNAY; DULUPÇU, 2019; MORENO; ROBLES; MARTINEZ; CALVO; MIRON, 2018; GONZÁLEZ-GARAY; POZO; GALÁN-MARTÍN; BRECHTELSBAUER; CHACHUAT; CHADHA; HALE; HELLGARDT; KOGELBAUER; MATAR, 2019; NAVAS; MONTES; ABOLGHASEM; SALAS; TOLOO; ZARAMA, 2020; TRAN; KUO; LU; KWEH, 2020; JIANG; LEE; RAH, 2020; MARTÍNEZ-CAMPILLO; FERNÁNDEZ-SANTOS, 2020; SALAS-VELASCO, 2019; MONCAYO-MARTÍNEZ; RAMÍREZ-NAFARRATE; HERNÁNDEZ-BALDERRAMA, 2020; BRZEZICKI; RUSIELIK, 2020; AGASISTI; SHIBANOVA; PLATONOVA; LISYUTKIN, 2019; HAMMES JUNIOR; FLACH; MATTOS, 2020; RAMÍREZ-GUTIÉRREZ; BARRACHINA-PALANCA; RIPOLL-FELIU, 2020), Avaliação de países através de seus respectivos índices de eficiência (MAMMADOV; ÇIMEN, 2019; KOSOR; PEROVIC; GOLEM, 2019; APARICIO; PERELMAN; SANTÍN, 2020; STUMBRIENE; CAMANHO; JAKAITIENE, 2019), e mostrar a evolução temporal da educação superior (JOHNES; VIRMANI, 2019; SCHILTZ; WITTE; MAZREKAJ, 2019; SEGOVIA-GONZALEZ; DOMINGUEZ; CONTRERAS, 2019; SONG; SCHUBERT; LIU; YANG, 2019; NADERI, 2019; APARICIO; CORDERO; ORTIZ, 2019).

Já no ano de 2021, as publicações tiveram foco em consolidar a literatura existente, com avaliação de cursos (TAVARES; MEZA, 2021), modelar a avaliação de performance (MA; SEE; YU; ZHAO, 2021), analisar sistemas educacionais (LE; AFSHARIAN; AHN, 2021), refletir o verdadeiro processo de incorporação de dados nas universidades (LEE; JOHNES, 2021; IBRAHIM; FADHLI, 2021; AGASISTI; BERBEGAL-MIRABENT, 2020), avaliar como os estudantes classificam sua instituição de ensino superior (DAULTANI; DWIVEDI; PRATAP, 2021), se existem diferenças significativas na eficiência educacional de estados (MA; LI, 2021), e avaliar estudantes e programas ((SHERO; OTAIBA; SCHATTSCHNEIDER; HART, 2021; LA HOZ; ZULUAGA; MENDOZA, 2021).

A Análise Envoltória de Dados e Educação possui diversas vertentes de estudo na literatura. A aplicabilidade e investigação científica nesta área emergem na avaliação da educação superior (BREU; RAAB, 1994;

SINUANY-STERN; MEHREZ; BARBOY, 1994) e na educação básica (THANASSOULIS; DUNSTAN, 1994) perpassa a mensuração da implementação de políticas públicas educacionais (JOHNES; JOHNES, 1995), é analisada como forma de alterar o viés político nas escolas (THANASSOULIS, 1996) até ser considerada como ferramenta de apoio à decisão para gestores educacionais (SARRICO; HOGAN; DYSON; ATHANASSOPOULOS, 1997; MARTÍN, 2006).

Além disso, a relevância da ferramenta acompanha as mudanças nos contextos educacionais pela qual são mensuradas a eficiência das reformulações do sistema de ensino (TYAGI; YADAV; SINGH, 2009; KATHARAKI; KATHARAKIS, 2010), alternativas de priorização (MONTONERI; LIN; LEE; HUANG, 2012) e diferentes pontos de eficiência entre instituições públicas e privadas (BAYRAKTAR; TATOGLU; ZAIM, 2013). Outrossim, o método permite o estudo da performance de departamentos (ALTAMIRANO-CORRO; PENICHE-VERA, 2014), docentes (ORAL et al., 2014) e estudantes (CHEN; CHEN; OZTEKIN, 2017).

CONSIDERAÇÕES FINAIS

A literatura de 1990-2021 corrobora o amadurecimento do uso de DEA na educação superior, sobretudo como instrumento de benchmarking e planejamento por metas em ambientes multiproduto. A produção concentra-se em países do hemisfério norte, com autores e periódicos ancorados em pesquisa operacional e políticas da educação.

As limitações da pesquisa, assim como demais trabalhos científicos afunilam-se na proposição de pesquisas futuras. Sugere-se a utilização das técnicas bibliométricas em outras aplicações de DEA, de maneira a formar um panorama geral em diferentes áreas. Ainda, é sugerida pesquisas em outras áreas temáticas não abordadas nesta pesquisa.

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