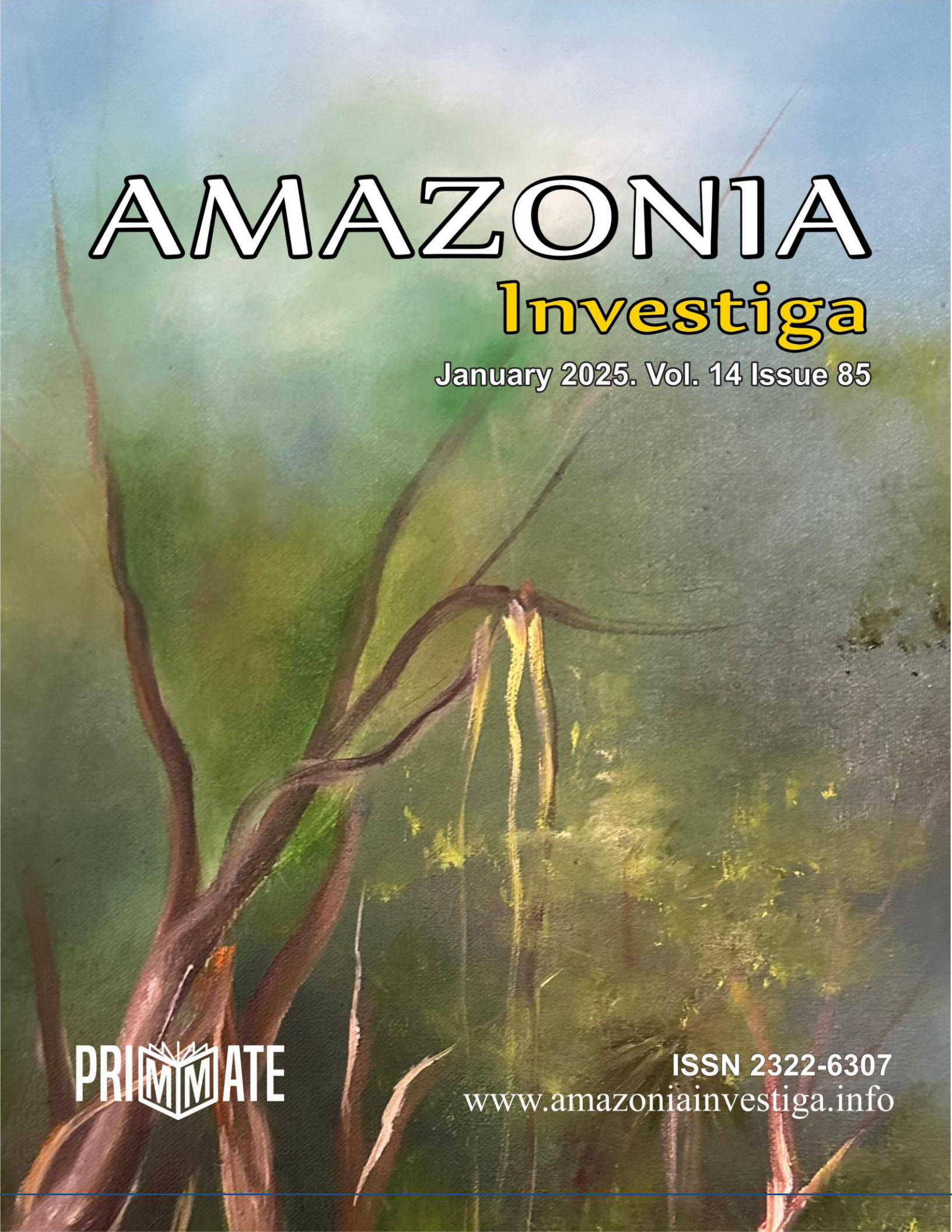
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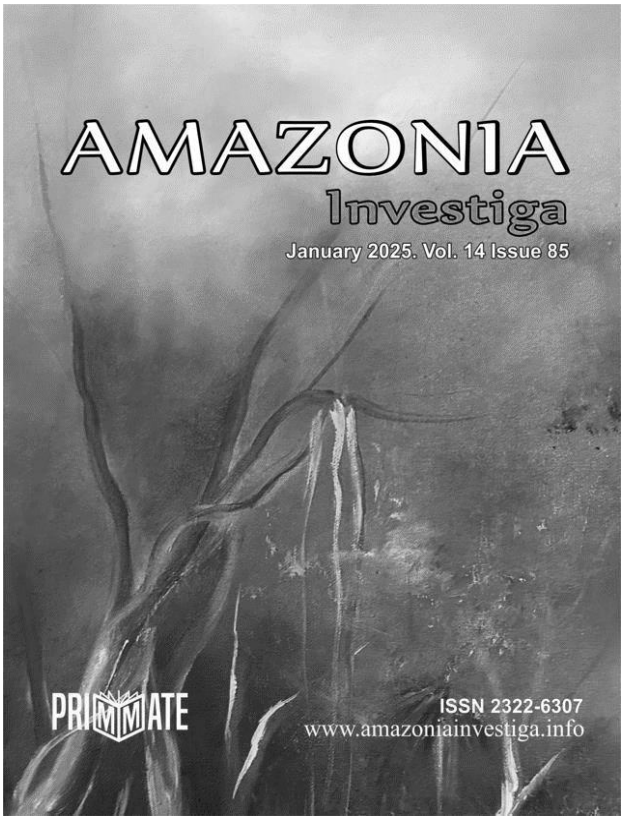

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O saber-fazer interdisciplinar: uma perspectiva sobre a atividade ceramista do bairro do Paracuri, Icoraci, Amazônia

The interdisciplinary know-how: A perspective on ceramic activity in the Paracuri neighborhood, Icoraci, Amazonia

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Resumo

No Distrito de Icoaraci – administrado pelo município de Belém – no bairro do Paracuri é realizada a reprodução artesanal e ancestral da cerâmica. As etapas de produção da cerâmica em Icoaraci, incorporam uma extensa cadeia de conhecimentos, dessa maneira o objetivo do trabalho é discutir a interdisciplinaridade no saber-fazer da atividade de ceramistas do bairro do Paracuri. Para isso, o trabalho foi realizado com base na visita técnica realizada na região, na qual foi acompanhada pelo método olhar, ouvir e escrever e por uma extensa revisão de literatura sobre o tema. Isso possibilitou identificar que a produção de objetos cerâmicos sofreu inúmeros processos de modificação ao longo dos anos e apesar dessas modificações, ainda é um processo de trocas de conhecimentos de geração em geração, transmitidos pela oralidade. Estes conhecimentos são complexos e, portanto, interdisciplinares, começam desde a coleta da matéria prima, havendo necessidade de um conhecimento sobre solos, até a etapa final, com a aplicação e fabricação de tintas e produção de ferramentas.

Palavras-chave: Cerâmica, Ancestral, Interdisciplinaridade, Produção Artesanal, Icoraci.

Abstract

In the district of Icoaraci, administered by the municipality of Belém, the Paracuri neighborhood is a significant center for the ancestral and artisanal production of ceramics. The creation of these pieces follows a process that involves an extensive chain of knowledge. Therefore, this study aims to analyze the interdisciplinarity present in the know-how of Paracuri's ceramists. The research was conducted through a technical visit to the region, employing the method of observation, listening, and written recording, complemented by an extensive literature review on the subject. The findings reveal that ceramic production has undergone various transformations over time; however, it remains a process of intergenerational knowledge transmission, primarily through oral tradition. These complex and interdisciplinary skills range from the collection of raw materials, which requires knowledge of soils, to the manufacture and application of dyes, as well as the production of tools.

Keywords: Ceramics, Ancestral, Interdisciplinarity, Artisanal Production, Icoaraci.

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Introdução

No Distrito de Icoaraci, administrado pelo município de Belém, no bairro do Paracuri, é realizada a reprodução artesanal e ancestral da cerâmica. A cerâmica aqui compreendida não diz respeito à Indústria Cerâmica, àquela destinada à fabricação de tijolos, pisos, dentre outros, com seus altos lucros e participação no PIB (Produto Interno Bruto) do país (Bustamante & Bressiani, 2000). Mas sim a cerâmica de produção em baixa escala como se depreende de Prous (2005), feita por pequenas parcelas da população que mantém vivo os saberes tradicionais de suas comunidades, a qual está presente desde antes da colonização do território que hoje se chama Brasil e presentes em registros arqueológicos.

Souza (2023) chama atenção pro fato de Icoraci apresentar sérios problemas sociais e econômicos, visíveis principalmente quando se analisam os dados do bairro do Paracuri. A autora destaca ainda que este bairro apresenta a menor renda per capita média, com R$ 305,73 (trezentos e cinco reais, e setenta e três centavos) do Distrito Administrativo de Icoaraci, e em se tratando do Índice de Desenvolvimento Humano municipal (IDH), com cerca de 0,62, considerado o mais baixo, comparado aos outros bairros da cidade.

Esses dados refletem a desvalorização da cultura tradicional e ancestral, desta atividade complexa cujos saberes-fazeres que compreendem a produção cerâmica são fruto de uma construção comunitária, em que indivíduos com diferentes níveis de conhecimento se reúnem para ensinar ou aprender, especialmente dentre unidades familiares, mantendo assim viva a tradição da região. Isso é a resistência de um povo, que apesar do pouco reconhecimento da atividade, permanecem vivos e mantendo a tradição - que frequentemente tenta ser replicada em alguns contextos empresariais.

Pensar em produções artesanais nos faz entrever a importância do saber e do fazer humano, os quais são reflexo da interpretação da natureza e a expressividade dos pensamentos (Leão & Farias, 2023). O modo de produção que respeita o tempo da natureza vai perdendo espaço no mundo moderno, que prioriza produção em larga escala ou invés de uma peça feita artesanalmente. Shiva (2003) aponta esse fenomeno como consequencia de um sistema que transforma a natureza e a sociedade gerando desigualdade e dominação, não concebendo outras formas de saber e assim deslegitimam outras profissões, sobretudo as que tem em sua base os saberes tradicionais, os quais assumem status de “primitivo” e “anticientífico”.

No entanto, os conhecimentos necessários e adquiridos para realização dessa atividade de produção ceramica são complexos e interdisciplinares, uma vez que cada artesão possui e precisa empregar ampla cognição ao executar cada peça. No entendimento de Leis (2011), a interdisciplinaridade é um processo de resolução de problemas complexos, que integra visões disciplinares diversas para construção de uma perspectiva mais abrangente. Segundo Souza (2023) estes artesãos possuem linguagem, técnicas, arte, conhecimentos, crenças, organização social, econômica e política. Assim, ao partir-se de Castro (2019), compreende-se que a prática da interdisciplinaridade consiste em criar uma base para produzir outras possibilidades ao conhecimento, e estimular o exercício de inversão do olhar, ou seja, reconhecer a diversidade social, étnica e de saberes presentes na região.

A produção do bairro do Paracuri iniciou-se com a produção de ceramica utilitária e marajoara, mas essa atividade se recria cotidianamente, transformada ao longo do tempo em arte própria da região, assumindo outros significados a medida em que é produzida. As pessoas não apenas criam, mas também se constituem na sua cultura (i)material e vinculam-se a ela, construindo suas relações sociais em torno dela. Souza (2023) reflete sobre isso e conclui que estes objetos ou artesanato ou arte são impregnados de um caráter simbólico que instrumentaliza a expressão da identidade destes grupos sociais.

Portanto a desvalorização dos saberes-fazeres das famílias ceramistas se constitui como uma perda de uma cultura. Os saberes e fazeres dos artesãos de Icoaraci expressam nas memórias marcas identitárias localmente amazônicas que emergem na interação com a natureza, e suas existências na arte cerâmica deste modo de vida. Assim, conforme explica Shiva (2003, p. 15) “o desaparecimento da diversidade corresponde ao desaparecimento de alternativas”, ou seja, quando não é pensada a diversidade de ecossistemas, sociedades, culturas, perpetua-se o silenciamento, apagamento e exclusão de toda uma população. E pensar de maneira a homogeneizar uma população é uma ameaça a vida.

Assim, a fim de contribuir com a difusão e valorização dos conhecimentos tradicionais amazonidas, o objetivo do trabalho é discutir a complexa interdisciplinaridade presente no saber-fazer da atividade de ceramistas do bairro do Paracuri. Para isso a principal fonte de dados são os saberes dos próprios mestres

no ofício e arte ceramista atuantes no bairro do Paracuri. Tais saberes têm que ser valorizados e protegidos a fim de garantir esse patrimônio preservado às gerações futuras.

Por uma abordagem metodológica

O Distrito de Icoaraci localiza-se a 20 km da cidade de Belém. E está situado entre a baía do Guajará e o rio Paracuri (Figura 1), o que configura essa área com grande disponibilidade de argila, sendo a cultura local voltada predominantemente para a atividade ceramista. Mas como se verá adiante, essa matéria prima antes precisa passar por um processo de limpeza.

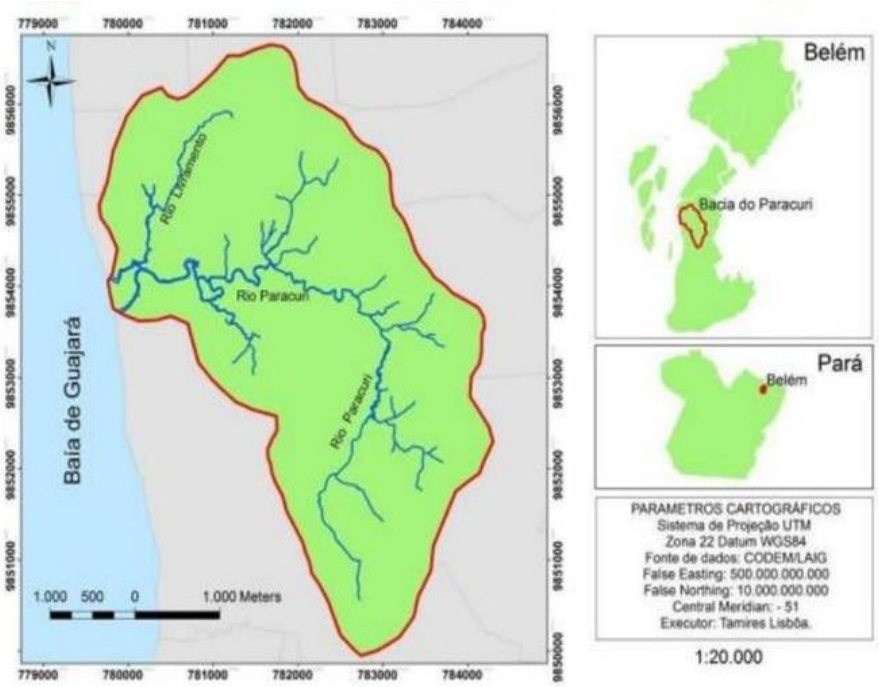

Figura 1. Localização do rio Paracuri
Fonte: Souza, 2019, p. 15.

O trabalho foi realizado a partir da visita técnica feita no bairro do Paracuri, no dia 17 de maio de 2024. Nesse momento, percorreu-se parte do Circuito Interativo do Patrimônio Cerâmico do Paracuri. E visitou-se o Liceu do Paracuri, as Olarias do Mestre Jones, Espanhol e Marivaldo Arte Cerâmica. Nesse momento, foi empregado o método proposto pelo antropólogo de Oliveira (1996): olhar, ouvir e escrever. Segundo de Oliveira (1996), "[...] esses atos estão previamente comprometidos com o próprio horizonte da disciplina, onde olhar, ouvir e escrever estão desde sempre sintonizados com o propósito dela, possibilitando que se obtenha um panorama fiel sobre a comunidade".

Além disso, com consentimento dos envolvidos foram produzidas fotografias durante a visita, a fim de garantir a visualização do processo de produção das cerâmicas. A partir de Simonian (2007),o uso de imagens nos registros do conhecimento contribui significativamente no sentido de identificar, analisar e entender o imaginário, as sensações e mesmo as realidades materiais. As contribuições da documentação fotográfica quanto ao ambiente, populações e culturas ainda no decorrer do século XIX tornaram-se fundamentais enquanto documento e imagens com possibilidades múltiplas de análise.

Ainda fez-se uma extensa revisão de literatura relevante sobre o tema. Isso possibilitou a construção do debate acerca dos saberes e fazeres dos ceramistas e a interdisciplinaridade a partir de teorias e autores que são referencia sobre o tema pesquisado, o que conferiu credibilidade e objetividade no desenvolvimento do trabalho.

Revisão de literatura

No processo de expansão do distrito de Icoaraci, o bairro do Paracuri foi ocupado predominantemente por famílias oriundas do arquipélago do Marajó, composto por pessoas de baixa renda (Alcântara et al., 2014). A área de expansão ocorreu, principalmente, em direção às baixadas, onde a argila é abundante. Como se vê em Santos (2012), a opção deles por essa área veio de uma antiga tradição em se trabalhar com esse tipo de matéria prima e pela facilidade que se tinha em encontrar jazidas de argila às margens dos rios Paracuri e Livramento (Figura 1).

De acordo com dos Santos (2012) a tradição de trabalhar com argila nesta região remonta ao século XIX quando Icoaraci era uma fazenda controlada pela Ordem dos Padres Carmelitas Calçados que possuíam uma olaria às margens do Igarapé Paracuri. Nesse período e como posto por Santos (2011), eram produzidos tijolos e outros utensílios semelhantes para construção de casas, que eram levados à Belém por via fluvial, por tanto os artesãos já tinham familiaridade com os modos de fazer objetos cerâmicos.

Nesse momento, a tradição ceramista da localidade também tem em seu início a produção de peças lisas e utilitárias. Por volta da década de 1950, houve a inserção da cultura "Marajoara" (Gomes et. al, 2019; Xavier, 2006). A cerâmica de Icoaraci foi uma fusão da cerâmica local e da cerâmica marajoara. Segundo Linhares (2010), o serigrafista Antônio Farias Vieira – mais conhecido como mestre "Cabeludo" – foi o precursor na mudança da cerâmica de Icoaraci. Mestre "Cabeludo" maravilhado com os traços e grafismos vistos no livro "Na Planície Amazônica" de Raymundo Moraes, começou-se a reproduzir os traços marajoaras na fabricação de suas peças cerâmicas, dando assim, um toque artístico nas peças.

Velhos ou novos objetos, a cerâmica de Icoaraci sobrevive ou sobreviveu a tudo isso. Xavier (2006) ressalta que as novas produções revelam práticas e ideias adquiridas via inúmeras instituições, mas que continuam estabelecendo ligação com o passado. Para esse mesmo autor, o estudo das tradições inventadas é interessante pois permite perceber o contraste entre as constantes mudanças e inovações do mundo moderno e a tentativa de estruturar de maneira imutável e invariável ao menos alguns aspectos da vida social. As novas produções do Distrito possibilitam perceber as modificações e inovações dos artesãos, pois são eles que produzem e se organizam através das constantes mudanças.

Neste ponto, importa saber que é nessa realidade que se deu início a formação de uma cadeia de artesãos, que há décadas formam e reforçam o poder da identidade cultural do Parcuri. Atualmente, no entendimento de Leão e Farias (2023) e de Lima Vieira, Alves e Pontes (2016), combinam-se traços da história indígena regional com inovação artística, isso fruto da originalidade criativa das artesãs e dos artesãos do Polo Ceramista de Icoaraci. O trabalho com a cerâmica é realizado prioritariamente em grupos familiares.

O artesanato local é a principal ou única atividade que garante o sustento das unidades familiares de Paracuri envolvidas com esta produção e parte do lucro das vendas depende diretamente do comércio local e do turismo no estado (Garvão, 2021). A produção de artefatos de cerâmica utilitária e da cultura indígena é diária e a arte marajoara "ganhou o mundo" pelas mãos dos artesãos de Icoaraci.

Nesse cenário, Potiguar et al., (2009) explicam que o mercado turístico ainda se mantém como principal consumidor desta cultura, por considerá-la exótica, mas contribuem ainda para resguardar, ainda que modificados, a identidade étnica e cultural daqueles que os fabricam. O consumo do artesanato amazônico como um produto do mercado, seja pelo turismo ou população local, fideliza um grupo de consumidores que são admiradores não só de um produto, mas de um conceito cultural. (Garvão, 2021). Por isso o turismo assume um importante papel vida das familias do Paracuri.

No trabalho de Potiguar et al., (2009) os artesão destacaram a importância do turista na valoração da produção artesanal do Paracuri, quando comparada aos próprios paraenses. Segundo Garvão (2021) e Potiguar et al., (2009) o incentivo o alcance dos turistas tem relação com a inclusão do Paracuri nos pacotes turísticos de visitação da cidade. Destaca-se mais recentemente a ação do governo municipal com a criação e inauguração do Ecomuseu que conta com o Circuito Interativo do Patrimônio Cerâmico do Paracuri, sendo está mais uma tentativa de fortalecer o mercado local e valorizar a cultura tradicional do Paracuri.

De acordo com Moreira Pinto, P., & Lopes Simonian (2015) o turismo é fato e um fenômeno típico da modernidade. Por isso, a partir de pesquisas científicas rigorosas, o turismo ajuda a resolver problemas sociais, demonstrando a possibilidade de utilizar novas contribuições teórico-metodológicas, que possibilitem

reflexões para além da abordagem economicista em que geralmente é tratado o turismo (Moreira Pinto, & Lopes Simonian, 2015). Pois essa atividade é fruto do acúmulo de saberes transmitidos por gerações, os artesãos detêm o conhecimento sobre as técnicas de extração e manipulação de matérias-primas variadas, transformando-as em objetos, criando e recriando a sua própria identidade e cultura.

O saber fazer interdisciplinar dos ceramistas

Nos caminhos percorridos no bairro do Paracuri, foi possível observar a cultura local e inúmeras pessoas trabalhando com argila nas portas de suas casas. Nesse percurso, buscava- se identificar os saberes presentes nessa atividade e a sua perspectiva interdisciplinar. Como afirma Raynaut (2014), a interdisciplinaridade possibilita entender questões do mundo que não se podem encaixar em domínios e categorias fechadas, De fato, ela está presente desde os tempos pré-históricos como por exemplo, na agricultura, onde os agricultores possuíam uma combinação de grande variedade de conhecimentos para realizar sua atividade.

Nesse sentido, a produção cerâmica é, assim como a atividade agrícola, um processo que as trabalhadoras e os trabalhadores do setor incorporam nas suas práticas uma pluralidade de conhecimentos, sendo aqui considerada uma atividade interdisciplinar. Ou seja, envolve a integração e a colaboração entre diferentes áreas do conhecimento para resolver problemas complexos e promover uma compreensão mais integrada de um determinado problema (Leis, 2011). Assim, essa abordagem transcende as barreiras tradicionais entre disciplinas, permitindo que métodos, teorias e dados de diferentes campos se combinem de maneira sinérgica.

A produção cerâmica desenvolvida pelas artesãs e pelos artesãos é ancestral e, portanto, se baseia nas técnicas de produção fruto de um conhecimento tradicional repassado geração para geração, via oralidade, transversalizada por um amplo conhecimento de diferentes áreas. Geração é entendida como o lugar em que dois tempos diferentes são sincronizados – o do curso da vida e o da experiência histórica. De modo que e a partir de Vieira, Reis e Santana (2021), o tempo biográfico e o tempo histórico fundem-se e transformam-se criando uma geração social em constantes relações e (re)configurações.

A autora Nascimento (2017) explica que as mestras e os mestres artesãos incorporam os saberes carismático, circunstancial, comunicacional, criativo, educacional, histórico-cultural, técnico e trans-local (Quadro 1). A autora descreve que esses conhecimentos são concebidos por vezes como "habilidades" (fazer), comportando-se como "atitudes" (ser). No entanto, estes são conhecimentos e/ou sensibilidades que tais mestres desenvolvem para a gestão das diversas demandas que seu *metiér* exige.

Quadro 1.
Saberes na maestria artesanal

Saber na Maestria Artesanal	
Saber	**Princípio Conceitual**
Saber carismático	Caracteriza-se pela proatividade, convencimento, liderança e iniciativa nas relações com os diversos públicos de diálogo.
Saber circunstancial	Conhecimento holístico e capacidade de gerir as circunstâncias que interferem no trabalho de maneira sincronizada, planejada e ágil. É um saber-agir em momentos de crise, conflito sou em momentos de calmaria, como um maestro que orquestra as diversas demandas e fatores que interferem, direta e indiretamente, na gestão do proceso.
Saber comunicacional	Reconhecimento da comunicação como instrumento multiplicador e de fundamental importância para a socialização/democratização de ideias, pensamentos, sentimentos. É o saber de "tornar comum", partilhar e consensuar, num processo dialógico e sob mecanismos diversos.
Saber criativo	Sensibilidade para a criação e inventividade de produtos, tecnologias etc. É um saber-fazer que motiva ações para descobertas, ressignificações, releituras, inovação.
Saber educacional	Saber ou sensibilidade para o repasse do conhecimento no ofício e seus macetes. Motivado pelo compromisso com a formação de novos aprendizes, parceiros de trabalho
Saber histórico-cultural	Conhecimento histórico-cultural-temporal-espacial do ofício. É o saber situar-se e integrar-se no valor simbólico, comportamental e identitário que marca o território laboral.
Saber técnico	Conhecimento e domínio das técnicas que regem o ofício. Marcado pela percepção dos diversos fatores que integram a atuação, conhecendo suas faces e detalhes, pontos fortes e fracos e tudo mais que sobre ela interfere.
Saber trans-local	Sensibilidade para o reconhecimento das oportunidades e adaptação às demandas para projeção profissional em âmbito trans-local. É o "saber-ver", o vislumbre de um caminho inédito ou não saturado para empreender ideias, projetos, fazeres.

Fonte: Nascimento (2017, p. 62).

A partir desse quadro adaptado de Nascimento (2017), é possível reconhecer a ampla variedade de conhecimentos reunidos pelos mestres artesãos ceramistas. Ao longo de sua vida incorporam habilidades de gerenciamento da produção, professores, comunicadores, além de desenvolverem sua habilidade enquanto artistas e profissionais técnicos. Posto isso, para Tavares (2012) é preciso reconhecer que o conhecimento tradicional é fruto de uma lógica complexa, que envolve processos sofisticados de construção e reconstrução, impensáveis sem uma atividade intelectual consciente.

Esse pequeno quadro já sistematiza como os conhecimentos em torno da cadeia criativa da cerâmica são arraigados de conhecimentos, configurando os saberes dos mestres artesãos como interdisciplinares. Segundo Tavares (2012), por meio desse processo, as artesãs e os artesãos expressam uma reflexão do mundo, construída por sua sensibilidade, conhecimento das técnicas e pelas relações sociais estabelecidas na produção. Assim, aqui apontaremos pelos caminhos percorridos no bairro do Paracuri no qual foi possível observar o cotidiano da região e perceber os conhecimentos empíricos dos mestres oleiros e como estes podem ser concebidos como interdisciplinares.

O processo cerâmico tradicionalmente engloba: aquisição da matéria-prima, beneficiamento e tratamento da argila, manufatura do objeto cerâmico e secagem, queima, acabamento final e embalagem (Xavier, 2006; Silva do Rosario et al., 2018). A cerâmica de Icoaraci se estabeleceu não apenas como mercadoria, mas como parte da cultura local. Num cenário onde o simbólico é um capital a cada dia mais valorizado, Nascimento (2017) explica que o artesanato não é só produção/produto, é também história, memória, identidade e tem valor imaterial, tendo suas referências culturais e saberes e fazeres tradicionais como principal diferenciador.

Fotografia 1. Amassador de argila.

O mestre Jones – primeira parada do itinerário – faz o beneficiamento do barro. Ele coleta a argila *in natura* e trabalha nela, com um amassador (Fotografia 1). Esse equipamento auxilia na remoção de galhos, folhas e outros tipos de impurezas, para que ela fique adequada à comercialização para outros artesãos que irão fabricar peças cerâmicas (Fotografia 2). À esquerda, têm-se folhas, galhos, raízes e outros materiais retirados no processo de beneficiamento da argila e à direita têm-se blocos de argila já beneficiados.

Fotografia 2. À esquerda impurezas e à direita blocos de argila já beneficiados.
Fonte: Acervo pessoal das autoras.

O mestre Jones explicou ainda como diferenciar uma argila de boa procedência daquela de má qualidade, na fotografia 3, ele mostra e explica que esse trata-se de um material de má qualidade (Fotografia 3). De acordo com o mestre, o barro precisa ser retirado de posições específicas, geralmente mais profundas, das barreiras para que possa ser moldado e ir ao forno. O barro ideal ao ser aquecido com o próprio calor do corpo humano fica mais maleável e fácil de trabalhar, enquanto aquele de má qualidade se quebra em contato com as mãos, sendo mais rígido, tornando a moldagem difícil e com altas chances de rachar as peças durante a queima no forno.

Fotografia 3. Argila de má qualidade**.**
Fonte: Acervo pessoal das autoras.

A partir das narrativas do senhor Jones, observou-se o conhecimento sobre as propriedades físico-químicas do solo. Os principais atributos físico-químicos associados ao solo são: textura, cor, plasticidade, adesividade, densidade, porosidade, permeabilidade, estrutura, capacidade de compactação, capacidade de água disponível, Matéria Orgânica, teor de Nutrientes, entre outras (Pereira, 2019). Esses artesãos têm um conhecimento empírico dessas propriedades e ao manusear o material ele está testando todas essas características e definindo o que pode ou não ser empregado na confecção de objetos cerâmicos.

Sociedades imersas em ambientes naturais utilizam uma metarracionalidade para compreender e explicar o mundo, uma ciência sensível e primordial (Silva do Rosario et al., 2018). Pois segundo Lévi-Strauss (1989), o saber tradicional se pauta pela "lógica do sensível", que valoriza a experiência direta e a percepção sensorial. Na Olaria do Espanhol, especialista em peças utilitárias, comandada atualmente por Mestre Ciro Croelhas, outros aspectos da fabricação das peças são revelados. Nesse local e conforme a Fotografia 4, foi possível observar os artesãos trabalhando em um torno, preparando as peças utilitárias.

Fotografia 4. Artesão oleiro moldando peça cerâmica em torno manual.
Fonte: Acervo pessoal das autoras.

Essa etapa exige muita habilidade do oleiro, que controla com os pés e as mãos o giro do torno e molde da peça confeccionada. Este é um fazer que somente é adquirido na prática, o qual segundo eles, aprenderam desde criança. E após a moldagem das peças em torno, elas passam por um processo de secagem inicial, para que uma parte da água presente na matéria prima evapore por processos naturais (Fotografia 5). Apenas após esse primeiro procedimento é que as peças vão para o forno, num outro método de secagem (Fotografia 6), para que a água restante seja completamente evaporada, tornando a peça resistente e durável.

Fotografia 5. Secagem das peças cerámicas.
Fonte: Acervo pessoal das autoras.

Fotografia 6. Forno para queima das peças.
Fonte: Acervo pessoal das autoras.

De acordo com Mestre Ciro, depois da secagem inicial ainda há água que ele chamou de "molecular" dentro dos objetos e está precisa evaporar no forno. Esse é aquecido gradativamente até por volta de 800ºC num processo que leva, em média, 24h para ser completado. O mestre destacou a primazia da condução térmica, pela qual os sólidos transferem calor através de movimentações moleculares.

Isso indica que os oleiros demonstram ter adquirido conhecimentos sobre física para garantir uma cerâmica de boa qualidade, resistente e durável. Sobretudo na olaria do Espanhol, a qual somente produz cerâmica utilitária e, portanto, o rigor pela durabilidade e resistência das peças é maior. Essa expertise, edificada sobre

tradições e observações empíricas, assegura a eficiência no processo cerâmico incorporando conceitos de condução, convecção e radiação.

O Mestre explicou que a partir de processos de experimentação testou diferentes temperaturas para entender o processo de queima das peças cerâmicas. Ele testou elevar a temperatura do forno para 1000°C a fim de obter maior velocidade no processo de queima das peças, o que resultou em peças com rachaduras. O mesmo acontece quando se aquece mais rápido o forno (ao alimentar com mais velocidade), as peças quebram e o trabalho feito se perde.

Percebe-se que o conhecimento sobre termodinâmica é presente em todo o processo de produção dos objetos cerâmicos, os mestres com sua abordagem detalhada e adaptativa, exemplificam a aplicação desses conhecimentos, maximizando a durabilidade e desempenho das peças. Dentro dessa matriz térmica, o ceramista, alinhando-se com a termodinâmica, manipula e controla variáveis associadas à transferência de calor.

Nos termos de Silva do Rosario et al., (2018), os mestres artesãos aplicam conhecimentos sobre transferência de calor, expansão térmica e princípios de temperatura para metamorfosear a argila em artefatos cerâmicos. Ao guiar-se por sentidos afinados e por experiências acumuladas, o ceramista determina a energia adequada e a disposição das peças no forno. Em sequência à queima no forno, as peças passam para o processo de pintura com pigmentos naturais e, por fim, envernizamento.

Na olaria do Mestre Marivaldo, os mesmos métodos são empregados, entretanto os processos são relativamente mais demorados uma vez que a especialidade desta olaria é a reprodução de peças arqueológicas da Amazônia. A mesma demonstra conhecimento extenso sobre arqueologia, história e cultura locais, uma jornada por saberes que começa antes mesmo da fabricação das peças. Aliado a este conhecimento, há também um conhecimento extenso sobre pigmentos naturais para realizar a pintura das peças com cores diferentes e um método de pintura para realizar o "envelhecimento" de certas réplicas arqueológicas.

Os artesão de icoraci, sobretudo os que estão incluidos Circuito Interativo do Patrimônio Cerâmico do Paracuri, dominam ainda um conhecimento de mercado e marketing. A característica distintiva das comunicações comerciais é o facto de transmitirem informações não ordinárias, mas economicamente importantes e significativas sobre as propriedades e características dos bens, o que permite vendê-los melhor. Desse modo, ao final da produção das peças ceramicas os artesão tem um produto final unico, marcado de regionalidade e ancestralidade, atraindo inumeros compradores.

Ser um artesão ceramista, para além de uma profissão, significa cultivar um vínculo específico com a terra e com o território. Isso é passado de geração em geração a partir de seus modos tradicionais de saber-fazer que permeiam o cotidiano desses sujeitos. A cultura cerâmica do Paracuri é ancestral e ao longo dos anos os mestres ceramistas reinvindicaram uma pluralidade de conhecimentos, ou seja, suas práticas são a materialização da interdisciplinaridade. Esse fenômeno interdisciplinar presentes no saber-fazer pode ser um dos fatores que contribuiu para a resistência dessa atividade até o presente.

Conclusão

A formação histórica do distrito de Icoaraci está vinculada desde o princípio à produção cerâmica. Ao ter-se em vista que a cultura é fruto de relações sociais, está em constante movimento e transformação, fato observado nos processos que compreende a cadeia produtiva e criativa da confecção de cerâmicas, especificamente no bairro do Paracuri. A produção cerâmica que anteriormente produzia essencialmente objetos utilitários, jarras, vasilhas, potes alguidares, passou a incorporar outras técnicas e produzir cerâmica marajoara. Apesar desses movimentos, os modos de fazer em sua essência permanecem, mas também foram adaptados, algumas etapas modernizadas.

Neste ponto, conclui-se, portanto, que o processo de produção de cerâmica no bairro do Paracuri é ancestral e o conhecimento desse processo ainda é transmitido de geração em geração pela oralidade. Estes incorporam uma extensa cadeia de conhecimentos, que começam desde a coleta da matéria prima, havendo necessidade de um conhecimento sobre solos, até a etapa final, com a aplicação e fabricação de tintas e produção de ferramentas. Nessa perspectiva e a partir Silva do Rosario, Cardoso e Saraiva (2018), o diálogo entre o mestre do saber e o aprendiz leva os sujeitos a estabelecer relações e a mobilizar processos cognitivos para definir suas concepções de mundo e de processos necessários para existência da comunidade.

Os saberes e fazeres tradicionais são, portanto, em sua essência interdisciplinar. Esse é um processo que se estabelece pela sensibilidade, garantindo a renovação e perpetuação dessa arte. De acordo com Santos e Ristow (2019), conhecimentos tradicionais que pertencem ao ser humano e não ao sujeito ou a uma instituição, são formas de resgatar um conhecimento complexo. Em um mundo complexo é cabal que a interdisciplinaridade emerja como alternativa para tentar entender e compreender diversos aspectos da realidade. A interdisciplinaridade representa o rumo não somente a outras ciências, mas o encontro com outros saberes e deve abrir caminhos necessários e possíveis.

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Online processing of verb-noun collocation for Chinese learners of English as a foreign language

中国英语学习者动名词搭配的在线加工

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Abstract

This study focused on two distinct Chinese groups of English as a Foreign Language (EFL) learners: those with advanced proficiency and those with basic proficiency. The objective was to explore the mechanisms used by Chinese EFL learners in processing and comprehending verb-noun collocations in an online context. The key metrics under consideration were learner response time, the influence of collocation appropriateness, and the alignment between their native language (L1) and English (L2). The findings reveal that: 1) The advanced learners demonstrated significantly faster reaction times overall, particularly when dealing with both appropriate and inappropriate collocations. 2) Accuracy was higher for appropriate verb-noun collocations compared to inappropriate ones, and the advanced group outperformed the basic group in this regard. 3) Notably, there was no significant difference in processing time between the two proficiency levels for both appropriate and inappropriate collocations. These results provide valuable empirical insights into the factors influencing EFL learners' online comprehension of verb-noun collocations, highlighting the role of L2 proficiency and the congruence with their L1.

Keywords: Online processing, verb-noun collocation, Chinese EFL learners, response time, L1-L2 congruence.

摘要

本研究以两组不同水平的中国英语学习者为研究对象：一组是高水平学习者，一组是基础水平学习者。研究目的是探索中国英语学习者在线加工和理解动名搭配的机制。考量的关键指标包括学习者的反应时间、搭配恰当性的影响，以及母语和英语之间的一致性。研究结果表明：1）高水平学习者总体上表现出更快的反应时间，尤其是在处理恰当和不恰当的搭配时；2）与不恰当的动名搭配相比，恰当的动名搭配的准确率更高，且高水平者在这方面表现优于基础组；3）值得注意的是，对于恰当和不恰当的搭配，两组学习者之间没有显著差异。这些结果为影响英语学习者在线理解动名搭配的因素提供了有价值的实证见解，强调了外语水平和母语水平之间一致性的作用。

关键字: 在线加工，动名搭配，中国英语学习者，反应时间，母语和英语的一致性

Introduction

The analysis of EFL learners' collocation errors in their L2 output has garnered significant attention (McCarthy & O'Dell, 2014, p. 2; Prodromou, 2003, p. 42). Additionally, Conrad and Biber (2005, p. 57) emphasized the role of collocation in imparting the extended semantics of words. Nesselhauf (2005, p. 7)

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further suggested that collocation is a stable word combination that demonstrates lexical cohesion. Recent studies have demonstrated that L1 and L2 collocations differ in their psychological processing paradigms (Wei, Yang, & Zhang, 2017, p. 103). When it comes to the native language, most collocations are deeply ingrained in the psychological structure of users. In the acquisition of the first language (L1), collocation knowledge typically evolves alongside the formation of vocabulary and conceptual systems. This involves numerous collocation patterns or frames, where specific words can activate the corresponding structures or frames (Wolter & Gyllstad, 2013, p. 480; Goldberg, 2019, p. 26). Conversely, L2 collocation knowledge primarily originates from classrooms and textbooks, with the accuracy of collocation largely dependent on the learner's vocabulary knowledge. Therefore, it poses a challenge for EFL learners to grasp the actual context of collocation, and they exhibit low sensitivity and recognition towards L2 collocation. In most instances, L1 thinking influences the processing speed of L2 collocation. EFL learners find equivalence collocations easier to accept and produce, whereas non-equivalence collocations tend to stimulate L1 thinking, resulting in interference and hindrance in the output of L2 collocation. Among all types of collocations, verb-noun collocation is generally perceived as the most challenging for EFL learners to master (Alruwaili, 2020, p. 2).

In recent years, the establishment of Chinese learner English Corpus (CLEC), along with advancements in corpus retrieval (Kita & Ogata, 1997, p. 229), statistical analysis, and other associated technologies, has furnished an extensive repository of authentic language data and innovative research perspectives for a deeper examination of the collocation patterns exhibited by Chinese EFL learners. Leveraging corpus-based research techniques, numerous Chinese scholars have delved into the verb-noun collocation errors present in the linguistic output of EFL learners, striving to comprehensively categorize these errors through extensive big data analysis (Zhang & Yang, 2009, p. 41). Nevertheless, a limited number of studies have integrated the corpus approach with the response time method, a prevalent tool in psycholinguistic research, to examine the linguistic output traits of Chinese EFL learners (Xia, Xia & Li, 2014, p. 69). Hence, this article seeks to explore the online processing of L2 verb-noun collocations among Chinese EFL learners by employing a combined corpus and real-time response time methodology.

Literature review

Previous research, conducted from diverse theoretical perspectives, has delved into the verb-noun collocation errors committed by Chinese EFL learners. The majority of these studies reveal that Chinese EFL learners encounter difficulties with verb-noun collocation, yet their proficiency in this area improves as their proficiency in L2 rises (Wang, Xu & Li, 2015, p. 15). Zhang and Li's (2016, p. 30) statistical analysis of the corpus of college English learners revealed that verb-noun collocation exhibited the highest error rate, accounting for 55.83% of all collocation errors. Zhang and Yang (2009, p. 42) categorized verb-noun collocation errors and identified numerous instances of improper verb usage in collocation. Laufer and Waldman (2011, p. 647) examined the production of verb-noun collocation in the English writing of EFL learners from three distinct proficiency levels (low, medium, and advanced) who were native speakers of Hebrew. By comparing the self-constructed learner English corpus with the Louvain Corpus of Native English Essays (LOCNESS), they discovered that learners across all levels employed appropriate English Verb collocation significantly less frequently than native English speakers. Advanced learners demonstrated a relatively higher level of accuracy, yet errors, particularly interlingual ones, persisted. While corpus-based research primarily focuses on the influence of L1 on the production of L2 collocation (Yamashita & Jiang, 2012, p. 665), the processing of verb-noun collocation among Chinese EFL learners remains unexplored.

Siyanova and Schmit (2008, p. 454) conducted a study on the processing of adjective-noun collocations among EFL learners in Russia. Their findings indicated that non-native English speakers exhibit slower processing speeds compared to native English speakers when it comes to collocation processing. Although advanced EFL learners are capable of producing appropriate English collocations, they still lag behind native English speakers in terms of sensitivity and fluency. Yamashita and Jiang (2012, p. 647) conducted a study comparing English collocation processing among native English speakers, Japanese English as a Second Language (ESL) users, and Japanese EFL learners. The experimental materials were categorized into two types: consistent collocations that can be translated directly between Japanese and English (e.g., "make lunch" and "heavy stone") and inconsistent collocations that cannot be translated directly (e.g., "kill time" and "slow learners"). Their findings revealed that both collocation consistency and English proficiency play crucial roles in verb-noun collocation processing.

Szudarski and Conklin (2014, p. 833) investigated the processing of English adjective-noun and verb-noun collocations among advanced English learners with Polish as their native language. They compared the short-term and long-term memory effects of rote rehearsal and enhanced rote rehearsal. Their findings indicated that both methods of rote rehearsal had no significant impact on learners' processing and acquisition of verb-noun collocations. This was attributed to the congruence effect between their first language (Polish) and second language (English). The experiment involved 30 inconsistent verb-noun collocations out of 40, while only one inconsistent adjective-noun collocation was included.

Previous research conducted by Wolter and Gyllstad (2011, p. 123) and Yamashita and Jiang (2012, p. 647) has revealed that EFL learners encounter challenges when dealing with inconsistent items. Cao (2016, p. 11) employed the method of cross-language priming conditions through a collocation semantic judgement task to assess the significance of Chinese word semantics in aiding Chinese EFL learners' acquisition of interlanguage collocations. Their results indicate that the learners' native language, Chinese, has a substantial influence on the process of acquiring target language collocations. Furthermore, the research suggests that Chinese lexical semantics may underlie the formation of interlanguage collocations among Chinese EFL learners. Consequently, it can be concluded that the processing of L2 vocabulary relies on the vocabulary of the native language, and the collocation patterns of the native language also exert an influence on the acquisition of L2 collocations (Choi, 2017, p. 403; Cao, Wen & Zhang, 2016, p. 27). The knowledge of the native language facilitates the extraction and processing of consistent collocations.

Cognitive linguistics maintains that the construction meaning of verb-noun collocation arises from the integration of two distinct semantic concepts, rather than a mere summation of verb and noun semantics (Goldberg, 2019, p. 87). When EFL learners engage in the recognition and meaning assessment of verb-noun collocation phrases, they inevitably draw upon the mental operation mechanisms of both their native language and the target language. Advanced EFL learners often approach verb-noun collocation from the lens of their L2 acquisition experience. However, in scenarios where L1 and L2 diverge, L1 acquisition experience acts as a hindrance (Gyllstad & Wolter, 2015, p. 296). Conversely, novice English learners tend to view verb-noun collocation through the prism of their L1 acquisition experience. When confronted with inconsistencies, the L1 learning experience takes precedence in semantic processing by activating the mental vocabulary and semantic framework of the native language. Ultimately, both L1 and L2 are stimulated via conceptual representation and task schema, and an inhibition mechanism is employed to reconcile the conflict between the two simultaneously stimulated languages. The degree of inhibition is contingent upon the English proficiency level of the EFL learners (Ma, Li & Guo, 2016, p. 35).

Methodology

Research questions

In this experiment, it is postulated that Chinese EFL learners varying in proficiency levels exhibit disparities in their response time when processing verb-noun collocations. Additionally, the experiment assumes that the congruence between their native language (L1) and English (L2) plays a pivotal role in their online processing of verb-noun collocations. These assumptions give rise to the following three research questions:

1. What is the overall performance of Chinese EFL learners in their online processing of verb-noun collocations?
2. Do learners differing in English proficiency levels exhibit disparities in their processing of noun-verb collocations? If so, what are the nature of these differences?
3. Does the congruence between learners' L1 and L2 influence their online processing of verb-noun collocations? If so, how does it do so?

To answer these inquiries, a 2x2 factorial design was employed in the experiment, encompassing the factors of English proficiency levels (high versus basic) and the appropriateness of collocations (appropriate versus inappropriate). The dependent variable measured was the response time.

Participants

The study was conducted with two distinct participant groups. Group 1 comprised of 20 doctoral students majoring in English from Beijing Foreign Studies University. This group consisted of 10 males and 10 females, with an average age of 34.7 years and an average of 22 years of English learning experience.

Participants in Group 1 were designated as advanced EFL learners for the experiment. In contrast, Group 2 encompassed 20 first-year undergraduate students from Beijing Sport University, also with 10 males and 10 females. These students were non-English majors and had an average English learning duration of 12 years, while their average age was 19.5 years. Participants in Group 2 were designated as basic EFL learners in the experiment. All participants were native Chinese speakers with normal corrected vision and were right-handed. Prior to the experiment, all individuals self-assessed their English proficiency using a 7-level scale. Independent sample T-test results indicated a significant difference in English proficiency between the two groups ($t = 9.395$, $df = 11$, $p < 0.05$), with Group 1 exhibiting significantly higher English proficiency than Group 2 (MD = 2.619). (Refer to Table 1 for further details.)

Table 1.
Essential details regarding the study participants.

Participants	Age	English learning period	Self-assessment of English proficiency
Advanced	M = 34.7	M = 22	M = 6.3
	SD = 4.786	SD = 4.855	SD = 0.488
Basic	M = 19.5	M = 12	M = 3.7
	SD = 1.225	SD = 1.673	SD = 0.516

Instruments

In the study, learner corpora were utilized as a powerful tool to search and screen prevalent verb-noun collocation expressions employed by EFL learners across various proficiency levels. This approach allowed us to gain a deeper understanding of the language patterns and preferences of EFL learners in their use of verb-noun collocations. To ensure reliability and validity, we sourced our expressions from three reputable corpora: the Chinese Learner English Corpus (CLEC, Gui & Yang, 2003), the Ten-thousand English Composition of Chinese Learners (TECCL, Xue, 2015), and the Louvain Corpus of Native English Essays (LOCNESS). These corpora provided a rich and diverse dataset, enabling us to identify verb-noun collocations that were appropriate for the experiment.

In contrast, inappropriate verb-noun collocations were derived from the interlanguage corpus of Chinese EFL learners. This approach allowed us to identify common errors and misuses of verb-noun collocations, providing valuable insights into the challenges EFL learners face when acquiring this linguistic feature.

To meet the experimental requirements, a comprehensive set of online processing test questions was compiled, focusing specifically on verb-noun collocation as the experimental material. The online processing test encompassed 120 collocation phrases, with 60 phrases designated for the formal experiments, 20 for practice, and 40 serving as fillers. This structure ensured that participants were gradually introduced to the task, with the practice questions helping them familiarize themselves with the format and requirements of the test.

The 60 pairings used in the formal experiment comprised 30 pairs of appropriate and inappropriate English collocations, presented in a randomized order. This randomization was crucial to eliminate any potential bias or order effects that could influence participants' responses. The content of the practice test materials differed from the formal test materials, although the presentation method and probability remained consistent. This approach ensured that the practice questions did not provide any unfair advantage to participants in the formal experiment. Fillers were chosen from the experimental materials of Cao (2016, p. 37), with 4 items being verb-noun collocation and 36 items not being verb-noun collocation. The inclusion of fillers helped to disguise the true purpose of the test, ensuring that participants' responses were not influenced by their knowledge of the experiment's objectives.

In order to ensure the authenticity and effectiveness of the test questions, the complied online processing test questions of verb-noun collocation were checked one by one in TECCL and LOCNESS to calculate their collocation strength. BFSU Collocator 1.0 (Xu & Jia, 2009) was employed for the calculation of collocation strength to examine mutual information (MI) and log-likelihood ratio. Liang, Li and Xu (2010, p. 96) claimed that MI reflected the mutual attraction between node words and collocation words, and the greater the MI, the higher the collocation. Hunston (1994) proposed that collocation with MI greater than three should be regarded as strong collocations, but it was easy to treat low-frequency words as strong

collocations. Hence, some scholars advanced the concept of MI3, that is, the co-occurrence frequency of low-frequency words and node words should be cubed to show strong collocations.

The log-likelihood ratio is recognized as an effective approach for assessing the strength of collocations. In the conducted experiment, the evaluation of verb-noun collocations necessitated attention to the span. Consequently, a combined approach of MI3 and the log-likelihood ratio was employed to offer a comprehensive assessment of collocation strength. The chosen verb-noun collocations were validated and affirmed through reference to the Oxford English Collocation Dictionary (Tables 2 and 3).

Table 2.
Partial list of inappropriate verb-noun collocations.

No.	Chinese priming phrases	Inappropriate verb-noun collocations	Oxford English Collocation Dictionary	TECCL		
				Freq.	MI3	Log-likelihood
1a	扩大知识面	*Enlarge one's knowledge	×	8	10.6161	74.0468
19a	学习知识	*Learn knowledge	×	99	16.773	420.5632
17a	看报	*See newspaper	×	31	15.2088	200.7103
34a	开阔视野	*Enlarge one's knowledge	×	2	10.4238	23.9029
5a	操作计算机	*Type a computer	×	1	2.8398	4.7923

* indicates inappropriate English verb-noun collocations; × signifies collocation not found in Oxford English Collocation Dictionary.

Table 3.
Partial sample of appropriate verb-noun collocations.

No.	Chinese priming phrases	Appropriate verb-noun collocations	Oxford English Collocation Dictionary	LOCNESS		
				Freq.	MI3	Log-likelihood
1b	扩大知识面	Broaden one's knowledge	√	2	7.3211	13.9048
19b	学习知识	Acquire knowledge	√	0		
17b	看报	Read newspaper	√	1	5.4863	11.7186
34b	开阔视野	Broaden one's horizon	√	0		
5b	操作计算机	Run a computer	√	4	5.8643	23.4397

Vilnius (2016, p. 2) proposed a distinction between adjacent and nonadjacent collocations. Specifically, adjacent collocations refer to the absence of intervening words between two collocation components, whereas nonadjacent collocations involve the presence of additional elements between the two components, often to provide additional contextual information. Given the impact of word proximity on processing time, we made adjustments to the material screening process to ensure that there are no intervening words between verb and noun collocations. However, articles (the, a, an) and pronouns preceding nouns were excluded from this constraint. Analysis using the independent sample t-test revealed no statistically significant difference in word length between appropriate and inappropriate collocations, with a t-value of -1.072, degrees of freedom (df) of 118, and a p-value of 0.286 (greater than 0.05). Cohen's d value was 0.52, indicating a moderate effect size. The mean difference (MD) was -0.633. These results are presented in Table 4.

Table 4.
Statistics of word length T-test for verb-noun collocations.

Word length (number of letters)	Appropriate (n = 60)		Inappropriate (n = 60)		*MD*	*t* (118)
	M	*SD*	*M*	*SD*		
	12.43	2.948	13.07	3.502	**-0.633**	**-1.072***

* $p > 0.05$

Procedures

Drawing upon a rich body of prior research conducted by Siyanova and Schmitt (2008, p. 429), Yamashita and Jiang (2012, p. 647), Szudarski and Conklin (2014, p. 833), and Cao (2016, p. 6), the current experiment was meticulously designed to encompass two distinct yet complementary components: a practice test and the formal experiment. The protocol for the practice test was meticulously crafted to mirror that of the formal experiment, ensuring that participants had the opportunity to familiarize themselves with the procedures and repeat the process until they were thoroughly acquainted with every step. This iterative approach aimed to eliminate any potential confusion or unfamiliarity that could have interfered with the accuracy and reliability of the final results.

To ensure that participants had achieved a satisfactory level of familiarity with the procedures, they were required to demonstrate their understanding and proficiency through a series of practice trials. Once they had demonstrated a consistent and proficient grasp of the tasks, they were ready to proceed to the formal experiment. This transition was seamlessly facilitated by the simple press of the space bar, marking a clear boundary between the preparatory phase and the main event. The experiment was conducted in a state-of-the-art soundproofed environment, designed to guarantee the integrity of the results and prevent any external distractions or interference. Participants were tested individually, ensuring that their attention and focus were not diluted by any external factors. This isolation also precluded any potential communication or collaboration between participants, ensuring that each individual's performance was a true reflection of their individual abilities and skills.

To further enhance the accuracy and readability of the experiment, the computer screens were configured with a crisp white background, a resolution of 1280×768, and carefully selected font settings. The font size was meticulously set to 32, ensuring that the text was large enough to be easily readable without any strain on the eyes. Chinese text was displayed in the classic Song typeface, renowned for its clarity and legibility, while English text was presented in the timeless Times News Roman font, renowned for its elegance and readability. These meticulous attention to detail aimed to maximize participant comfort and minimize any potential distractions, ensuring that the focus remained squarely on the experiment and the tasks at hand.

The formal experiment proceeded in a precise sequence. Firstly, a red "+" fixation point was presented for 250 milliseconds to orient the participants' attention. Then, a priming phrase, specifically a Chinese verb-noun collocation, was displayed for 800 milliseconds. Subsequently, the English translation corresponding to the Chinese verb-noun collocation was shown for 5000 milliseconds. Participants were instructed to promptly respond by pressing the designated button - D for appropriate collocations and K for inappropriate ones - to indicate whether the target phrase was appropriate or not. If no response was made within the allocated time, the system automatically moved on to the next stimulus. Prior to the formal experiment, all participants underwent a practice session to familiarize themselves with the testing procedures. It was ensured that each participant encountered 100 questions during the formal test, of which 40 were fillers and did not contribute to the data collection.

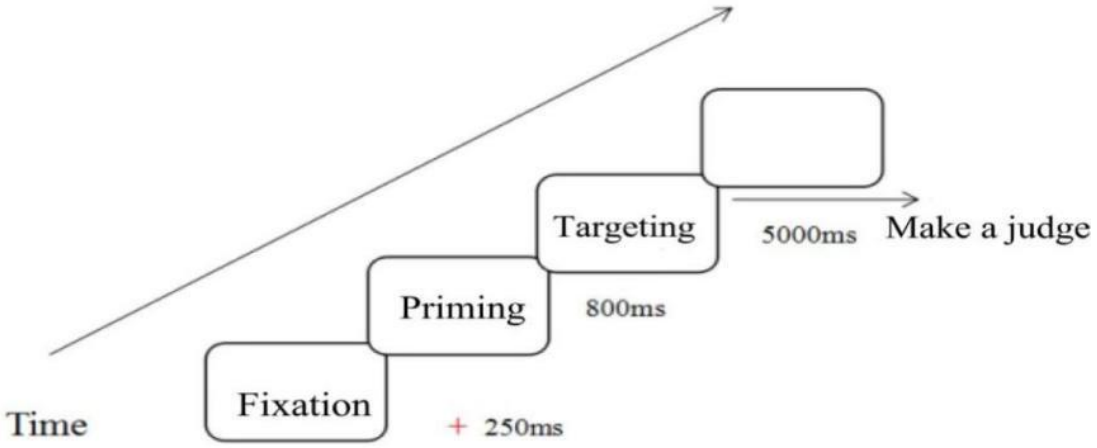

Figure 1. Experimental flowchart for verb-noun collocation response times.

Results and discussion

During the data processing stage, aside from considering the overall response time of the subjects, any data containing incorrect responses from the subjects were excluded. Additionally, any invalid data, defined as having a response time exceeding two standard deviations from the mean value or a recorded response time of 0, were also disregarded. Out of the collected dataset, 39% were identified as incorrect, while 6.5% were determined to be invalid. Following the prescribed experimental protocol, the experimental findings were then presented and discussed from the perspectives of response time, processing accuracy, and the appropriateness of the collation process.

Online processing response time overview

Based on the results of an independent sample test conducted with valid data, without excluding subjects' erroneous responses, it was evident that there existed a statistically significant difference in the response time among Chinese EFL learners of varying proficiency levels when processing verb-noun collocations ($t = -4.549$, $df = 727$, $p = 0.000 < 0.05$, Cohen's $d = 0.21$). Specifically, the high-level group of EFL learners demonstrated significantly faster response times compared to the low-level group (Mean Difference = -211.342) (see Table 5 for detailed data).

Table 5.
Average response time comparison between advanced and basic groups.

Response time	**Advanced (n = 397)**		**Basic (n =332)**		***MD***	***t* (727)**
	M	*SD*	*M*	*SD*		
	1330.45	485.922	1541.80	758.059	**-211.342**	**-4.549***

(Error response included)
* $p < 0.05$

After excluding the erroneous responses from the subjects, the results of the independent sample T-test conducted on the valid data revealed significant disparities in the processing response time among Chinese EFL learners of various proficiency levels when dealing with verb-noun collocations. Specifically, the test statistics were as follows: t = -3.953, degrees of freedom (df) = 443, and p-value = 0.000, which is less than the significance level of 0.05. Additionally, the effect size, measured by Cohen's d, was 0.27. Notably, the response time of advanced Chinese EFL learners was significantly faster compared to that of basic learners, with a mean difference (MD) of -223.050. These findings are summarized in Table 6 and suggest that there are notable variations in the average response time for target collocations among learners at different English proficiency levels.

Table 6.
Average response time comparison between advanced and basic groups.

Response time	Advanced (n = 262)		Basic (n =193)		*MD*	*t* (443)
	M	*SD*	*M*	*SD*		
	1302.95	476.773	1526.00	713.421	**-223.050**	**-3.953***

(Error response excluded)
* $p < 0.05$

The independent sample T-test revealed significant disparities in the response time of appropriate verb-noun collocations among Chinese EFL learners across different proficiency levels (t = -3.030, df = 276, p = 0.003 < 0.05, Cohen's d = 0.39). Notably, the response time of the learners in the advanced proficiency group was significantly faster compared to those in the basic proficiency group (MD = -212.031). These findings are presented in Table 7.

Table 7.
Average response time for appropriate verb-noun collocations between advanced and basic groups.

Response time	Advanced (n =152)		Basic (n =126)		*MD*	*t* (276)
	M	*SD*	*M*	*SD*		
	1238.07	443.830	1450.10	711.942	**-212.031**	**-3.030***

* $p < 0.05$

Based on the results of the independent sample T-test, it is evident that there exist substantial disparities in the processing response time among Chinese EFL learners of varying proficiency levels when dealing with inappropriate verb-noun collocations. Specifically, the test statistics reveal a t-value of -3.196 with a degree of freedom of 165, resulting in a p-value of 0.002, which is less than the significance level of 0.05. Furthermore, the effect size, measured by Cohen's d, is 0.46, indicating a moderate to large difference between the groups. Notably, the response time of the high-level EFL learners was significantly faster compared to that of the basic-level learners, with a mean difference (MD) of -301.172 (Table 8).

Table 8.
Average response times for inappropriate verb-noun collocations between advanced and basic groups.

Response time	Advanced (n =110)		Basic (n =57)		*MD*	*t* (165)
	M	*SD*	*M*	*SD*		
	1392.60	507.378	1693.77	693.654	**-301.172**	**-3.196***

* $p < 0.05$

The above results indicate that learners with varying levels of English proficiency exhibit notable disparities in the average response time for both appropriate and inappropriate collocations. This finding suggests that language proficiency plays a crucial role in the speed and accuracy with which learners process and recognize appropriate word combinations. It may also imply that learners at different proficiency levels employ different strategies or have varying degrees of familiarity with certain collocations, leading to varying response times. Understanding these differences can help educators and language learners alike design more effective teaching and learning strategies to improve language proficiency and fluency.

Chinese EFL learners' online processing accuracy rate

In terms of processing accuracy, both item analysis and subject analysis demonstrated that the overall accuracy rate was 61%, which fell within the average range (M=34.23, SD=6.60). Specifically, the accuracy rate for appropriate verb-noun collocations exceeded that for inappropriate ones, reaching 76.2% and 45.9% respectively. Additionally, the high-level group exhibited a slightly higher overall accuracy rate than the basic-level group, with percentages of 66.0% and 55.1% respectively.

When comparing the accuracy rates of appropriate and inappropriate verb-noun collocations, it was evident that the former had a higher accuracy rate of 76.2% (M=21.38, SD=3.45). Furthermore, the online processing accuracy of the high-level and basic-level groups was comparable, with percentages of 76.0% and 76.4% respectively. Conversely, in terms of inappropriate verb-noun collocations, the subjects' accuracy rate was average, with an overall accuracy rate of 45.9% (M=12.58, SD=6.39). Notably, the high-level group performed better than the basic-level group, achieving accuracy rates of 55.3% and 34.5% respectively. (Refer to Table 9 and 10 for further details.)

Table 9.
Accuracy rate of verb-noun collocations between advanced and basic groups.

Subjects	Accuracy rate		
	Overall	Appropriate collocations	Inappropriate collocations
Advanced	66.0%	76.0%	55.3%
Basic	55.1%	76.4%	34.5%
Overall	61.0%	76.2%	45.9%

(Item analysis)

Table 10.
Accuracy rate of verb-noun collocations between advanced and basic groups.

Subjects	Accuracy rate		
	Overall	Appropriate collocations	Inappropriate collocations
Advanced (n =7)	*M* *SD* 37.43 6.85	*M* *SD* 21.71 2.63	*M* *SD* 15.71 6.10
Basic (n =6)	*M* *SD* 30.50 4.13	*M* *SD* 21.00 4.47	*M* *SD* 9.50 5.32
Overall	*M* *SD* 34.23 6.60	*M* *SD* 21.38 3.45	*M* *SD* 12.85 6.39

(Subject análisis)

Chinese EFL learners' response time in processing verb-noun collocations

The paired sample T-test was conducted to investigate the processing speed of EFL learners in the advanced learners when dealing with appropriate and inappropriate verb-noun collocations. The results of the statistical analysis revealed that there was no significant difference in their response time when processing these two types of collocations. Specifically, the test statistic value (t) was 1.012, with a degree of freedom (df) of 190. The p-value was found to be 0.191, which is greater than the commonly accepted significance level of 0.05. This indicates that the difference observed in the response time was not statistically significant. Additionally, the effect size (Cohen's d) was 0.29, indicating a small effect, and the mean difference (MD) was 44.702. The findings suggest that Chinese EFL learners in the high-level group are equally efficient in processing both appropriate and inappropriate verb-noun collocations. This may be due to their proficient language skills, enabling them to recognize and handle collocations with equal ease, irrespective of their appropriateness (Table 11).

Verb-noun collocations are crucial in English language learning as they contribute significantly to the fluency and accuracy of language use. The ability to process these collocations efficiently is particularly important for advanced learners who aim to communicate effectively in English. The results of this study suggest that Chinese EFL learners in the high-level group possess this crucial skill, which is essential for achieving proficiency in the language. The results of the paired sample T-test indicate that there is no significant difference in the response time of Chinese EFL learners in the high-level group when processing appropriate and inappropriate verb-noun collocations. This finding highlights the efficiency of these learners in processing collocations, regardless of their appropriateness, which is crucial for achieving proficiency in English.

Table 11.
Average response time of advanced learners in both types of collocations.

Response time	Appropriate (n =191)		Inappropriate (n =191)		*MD*	*t* (190)
	M	*SD*	*M*	*SD*		
	1346.39	496.159	1301.69	463.005	**44.702**	**1.012***

* $p > 0.05$

The results of the paired sample T-test indicated that there was no statistically significant difference in the response time exhibited by Chinese EFL learners in the basic-level group when processing both appropriate and inappropriate verb-noun collocations. The test statistics revealed a t-value of -0.525 with a degree of freedom of 154, resulting in a p-value of 0.271, which was greater than the significance level of 0.05. Additionally, the effect size measured by Cohen's d was 0.23, and the mean difference (MD) was -38.574 (Table 12).

Table 12.
Average response time of basic learners in both types of collocations.

Response time	Appropriate (n =155)		Inappropriate (n =155)		*MD*	*t* (154)
	M	*SD*	*M*	*SD*		
	1496.59	764.609	1535.16	751.754	**-38.574**	**-0.525***

* $p > 0.05$

The results indicate that there is no noteworthy difference in the response speed exhibited by Chinese EFL learners at different proficiency levels when processing the two types of verb-noun collocations. Furthermore, a two-factor ANOVA revealed that English proficiency significantly influenced the processing response time of Chinese EFL learners ($F(1,668) = 16.376$, $p = 0.000<0.05$), whereas the appropriateness of collocation did not have a significant effect ($F(1,668) = 0.004$, $p = 0.948>0.05$). Specifically, learners with higher proficiency levels demonstrated significantly faster response times compared to those with lower proficiency levels. However, the appropriateness of collocation had minimal influence on learners' processing speed, and no significant difference was observed between the response times of learners processing appropriate and inappropriate collocations (refer to Table 13). Additionally, English proficiency and collocation appropriateness did not exhibit a significant interactive effect on the response time of Chinese EFL learners ($F(1,668) = 0.772$, $p = 0.380>0.05$, Cohen's $f2 = 0.01$) (Figure 2).

Table 13.
Response time statistics of advanced and basic learners.

Respo-nse time	Advanced learners （n =382)				Basic learners （n =310)			
	Appropriate （n =191)		Inappropriate （n =191)		Appropriate （n =155)		Inappropriate （n =155)	
	M	SD	M	SD	M	SD	M	SD
	1346.39	496.159	1301.69	463.005	1496.59	764.609	1535.16	751.754

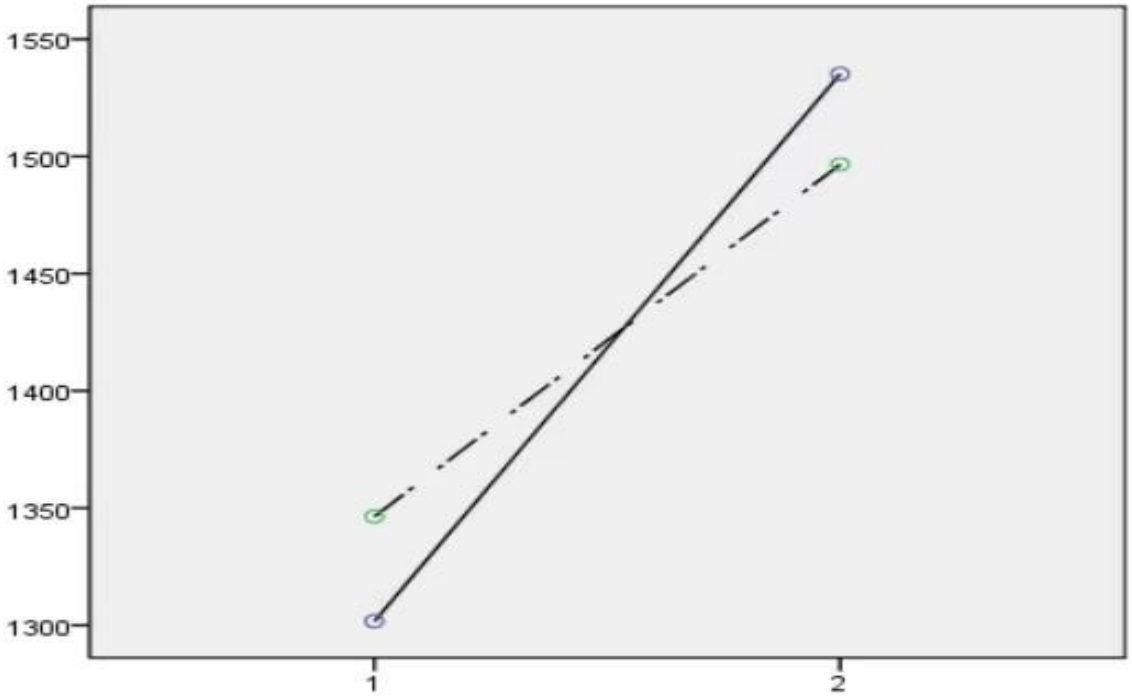

Figure 2. Correlation between English proficiency and appropriateness of collocation on response time.

The results show that Chinese EFL learners at different proficiency levels have no significant difference in response speed when processing two types of verb-noun collocations. A two-factor ANOVA reveals that English proficiency significantly affects the processing response time, with higher proficiency learners having faster response time, while the appropriateness of collocation has little impact and no significant difference is found between processing appropriate and inappropriate collocations. Moreover, there's no significant interactive effect between English proficiency and collocation appropriateness on the response time of these Chinese EFL learners.

The independent sample T-test results clearly show that Chinese EFL learners of different proficiency levels have significantly different processing response times for inappropriate verb-noun collocations. The negative t-value of -3.196, with 165 degrees of freedom and a p-value of 0.002 (less than 0.05), indicates a real difference between the groups. The Cohen's d-value of 0.46, suggesting a moderate to large effect size, further emphasizes the distinction. The mean difference of -301.172 shows that high-level learners respond much faster. For processing accuracy, the overall 61% accuracy rate (M = 34.23, SD = 6.60) being in the average range is a significant finding. The fact that the accuracy rate for appropriate collocations (76.2%) is much higher than that for inappropriate ones (45.9%) indicates that learners are better at recognizing correct combinations. Also, the high-level group having a higher overall accuracy rate (66.0% compared to 55.1% of the basic-level group) shows the influence of proficiency on accuracy.

Previous research on EFL learners' processing of collocations may have found different results depending on factors such as the sample characteristics (e.g., age, learning environment), the types of collocations tested, and the measurement methods. Some studies might have focused more on native-like collocation use rather than just response time and accuracy. For example, Digtyar et al. (2023) have found that in a different language learning context, proficiency had a different impact on collocation processing, perhaps due to more exposure to authentic language materials in their sample.

From a psycholinguistic perspective, the difference in response times could be related to the mental lexicon organization. High-level learners may have a more interconnected and efficient mental lexicon, allowing them to retrieve appropriate verb-noun collocations more quickly. For accuracy, the schema theory can be applied. Learners may have developed schema for appropriate collocations through more exposure and practice, which helps them identify correct combinations more accurately. The lower accuracy for inappropriate collocations might be due to less-developed inhibitory mechanisms to reject incorrect combinations.

The study sheds some light on improving EFL teaching methods and curriculum design. In the first place, teachers should be encouraged to design activities that enhance learners' awareness of collocations. For example, using corpus-based materials to show the frequency and usage of appropriate and inappropriate collocations. This can help learners build a more accurate mental representation of collocations. Secondly, more collocation-focused exercises need to be incorporated in the curriculum, especially for lower-proficiency learners. And more opportunities for practice and feedback to improve both response time and accuracy should be provided to students as well. In the third place, it is important for teachers to recognize the different needs of EFL learners at various proficiency levels. High-level learners can be challenged with more complex collocations and real-life language tasks, while basic-level learners can start with more common and simple collocations.

Limitations of the study are as follows: the sample might not be representative of all Chinese EFL learners. It could be limited in terms of geographical location, educational background, or age range. A more diverse sample would improve the generalizability of the results. What's more, the study only focuses on verb-noun collocations. Other types of collocations, like adjective-noun, adverb-verb collocations, might have different processing patterns. Also, the task used to measure response time and accuracy may not fully capture the complexity of real-life language use. Future studies should be conducted with a larger and more diverse sample of Chinese EFL learners, including those from different educational systems, regions, and age groups. And the processing of different types of collocations is going to be investigated to get a more comprehensive understanding of how proficiency affects collocation processing. To get more reliable results, more ecologically valid tasks will be developed to measure collocation processing, such as using natural language in context rather than isolated collocations.

Conclusions

This article delves into the intricate realm of online processing of verb-noun collocations among Chinese EFL learners. Specifically, we delve into the three critical aspects: response time, accuracy rate, and the influence of L1-L2 congruence. The findings of this study offer valuable insights into the online processing mechanisms of EFL learners, providing empirical support for the influence of proficiency level and L1-L2 congruence. Firstly, the analysis of response time reveals a significant difference between advanced and basic EFL learners. This observation is particularly noteworthy as it highlights the role of proficiency level in online processing. Precisely, advanced learners demonstrate a shorter average response time overall, indicating a more efficient processing mechanism. This efficiency is further emphasized in the processing of appropriate verb-noun collocations, where advanced learners exhibit a quicker response time. This finding suggests that proficiency level plays a crucial role in determining the speed and efficiency of online processing among EFL learners.

Secondly, in terms of collocation accuracy, the study finds that the overall accuracy for appropriate collocations surpasses that of inappropriate ones. This finding is significant as it underscores the importance of accurate collocation use in language processing. Furthermore, advanced learners exhibit greater precision in their use of appropriate collocations, further emphasizing the role of proficiency level. This precision is not only reflected in their overall accuracy but also in their ability to distinguish between appropriate and inappropriate collocations. Lastly, the study examines the time taken by advanced and basic learners to process both appropriate and inappropriate verb-noun collocations. Surprisingly, there is no substantial difference in the time taken by these two groups. This finding challenges the common assumption that proficiency level solely determines processing speed. Instead, it suggests that other factors, such as L1-L2 congruence, may also influence processing time. This observation is particularly intriguing as it opens up new avenues for further research into the role of L1-L2 congruence in online processing among EFL learners.

Overall, this research offers a comprehensive understanding of the online processing of verb-noun collocations among Chinese EFL learners. The findings highlight the influence of proficiency level and L1-L2 congruence in determining response time, accuracy rate, and overall processing efficiency. These insights are invaluable for language teachers and learners alike, as they provide a foundation for improving language processing skills and enhancing language proficiency.

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Idioms in academic writing: A Ukrainian university case

Використання ідіом в академічному письмі: на прикладі текстів українських студентів

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Abstract

This study investigates the use of idiomatic expressions in academic writing by Ukrainian university students learning English as a foreign language. The research analyzes the frequency of idiom use in essays written by two groups of students: one group explicitly taught academic English idioms and a control group. Findings reveal that Ukrainian students employ idiomatic expressions more frequently than native English speakers, as evidenced by comparisons with the British Academic Spoken English (BASE) corpus and the Michigan Corpus of Academic Spoken English (MICASE). Notably, even the control group exhibited higher idiomaticity than their native-speaker counterparts. These results highlight the importance of addressing idiomatic language in academic English instruction for non-native speakers. The study discusses the potential benefits and challenges of incorporating idioms into teaching materials and provides insights for educators aiming to improve the phraseological competence of their students.

Keywords: Idioms, metaphorical language, academic writing, corpus data, formulaic competence.

Анотація

У статті досліджуються особливості використання ідіоматичних виразів в академічному письмі на основі текстів, написаних англійською студентами філософського факультету українського внз. У дослідженні було проаналізовано тексти двох груп українських студентів: Група 1, яка вивчала ідіоми на занятті з загальної та академічної англійської, та Група 2 (контрольна). Виявилося, що частотність застосування ідіом українськими студентами була вищою, ніж зафіксована в британському корпусі усної академічної англійської та у корпусі академічних текстів Мічиганського університету. Цікаво, що частотність використання ідіом навіть у контрольній групі виявилася вищою, ніж у студентів англомовних університетів. Результати дослідження свідчать про важливість вивчення ідіоматичної мови у курсі англійської для академічних цілей. У розвідці також обговорюються переваги і складнощі включення вправ з ідіоматичних виразів до навчальних матеріалів і пропонуються можливі шляхи підвищення фразеологічної компетентності студентів.

Ключові слова: Ідіоми, метафорична мова, академічне письмо, корпусні дані, ідіоматична компетентність.

Introdution

University students' competence at academic writing (AW) has been recognized as an important constituent of their successful professional career, which requires not just the ability to generate a scientific idea, but also to convey it to the scientific community by adhering to the principles and conventions accepted in academic discourse. Although the domain of AW leans towards straightforward formulations that sound factual, accurate and explicit, it does not mean that any use of figurative language is out of place in this

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field. On the contrary, relevant idioms or metaphors can contribute to formulating one's scientific concept in a more vivid way, making it easier for the reader to grasp, or to enriching the author's lexical repertoire and giving a break to the audience from a plain, purely scientific style.

Figurative language, which comprises idiomatic expressions, is universally considered to be a hard nut to crack for foreign language learners. Ta'amneh (2021) states that learning English is a difficult task overall due to the lack of students' exposure to the target language in daily life, while mastering idioms is possibly hardest of all. A lot of scholars agree that the challenges in acquiring figurative language are caused primarily by the fact that the overall meaning of idiomatic expressions is normally quite different from the meanings of their constituent words, which is at times complemented by their deceptive transparency (Szudarski, 2017; Park & Chon, 2019). Other researchers emphasise cultural differences and the lack of direct idiomatic equivalence – incongruency – between the learners' L1 and L2, which contribute to the confusion (Stamenkoska, 2017; Peters, 2016; Snoder, 2017; Lysanets & Bieliaieva, 2023; Rahmtallah, 2024).

Thus, on the one hand, learning a foreign language is rendered more difficult because of having to master its idiomatic aspect, while on the other hand, a solid command of idiomatic formulae enhances both the quality of expressing oneself in L2, as well as comprehending the message uttered in L2 (Szudarski, 2017; Simpson & Mendis, 2003). Given the complexity of acquiring formulaic language, it would be logical to assume that the number of idiomatic collocations used in the academic writing by Ukrainian students would be lower than that of students of an American university.

My research therefore seeks to investigate this assumption and to find out if idioms are indeed employed by Ukrainian university students in their academic texts, written in English. Other aims of my paper are to analyse if the fact of explicitly discussing the use of idiomatic language in academic domain has affected the actual number of idiomatic expressions in the learners' written output, and to compare the possible instances of idiom occurrence in the texts by Ukrainian students with that in the academic writing of their American counterparts, both the overall frequency and the rate of individual idiom use.

The article includes the following sections:

- Literature review: reviews the existing research into figurative language and points out the available data of its use in academic discourse, highlighting the multiplicity of definitions employed to describe idiomatic sequences and the ambiguity of findings available as for their use in the academic domain;
- Methodology: describes the participants of the research, the methods employed in the study, and the procedure of the present investigation;
- Results and discussion: presents the findings of the study and discusses the specific features of the idiomatic language use identified in the texts by Ukrainian students;
- Conclusions: summarises the findings of the research, addresses its limitations, highlights the practical implications of the study and suggests prospects of future research in the field.

Literature Review

It has been suggested by linguistic research that natural language is permeated with metaphor, whose "locus is not in language but in the way we conceptualize one mental domain in terms of another" (Lakoff, 1993, p. 202), thus making it an inherent feature of human thinking. Idioms, which could be defined as a subcategory of metaphorical language (Lazar, 2003), are viewed as part and parcel of popular culture, fiction, and everyday speech, however, their usage is not restricted to the above linguistic areas, with idiomaticity having been recognized to be a common feature of academic speech and writing (Miller, 2020; Vongpumivitch, Yu, & Nguyen, 2023; Simpson & Mendis, 2003; Biber & Barbieri, 2007; Ädel & Erman, 2012; Shin, 2019). According to Miller (2020), deliberate avoidance of idiomatic language in one's AW may be a sign of a lack of phraseological competency, which can mark a writer out as uninformed of the conventions of a discourse community.

A special role of metaphorical language in academic discourse is analysed in the research by J.B. Herrmann (2013), who points out a higher percentage of "metaphor-related words" in academic realm compared to other contexts, such as news, fiction or conversation. In the academic context, metaphors can reveal the ways of conceptualisation of abstract notions and ideas, typical for a specific culture, as well as contribute to the distinct sounding of an authorial voice in a scientific text, and thus be viewed as a means of

formulating evaluation. Other functions of figurative language singled out by scholars include reference of an entity, creating textual cohesion, providing illustrative explanation, paraphrasing, creating a sense of group identity, or signposting a change of topic (Herrmann, 2013; Ruskan et al., 2023; Simpson & Mendis, 2003). The numerous roles played by metaphorical expressions in constructing a text add to the list of reasons why teachers need to address idiomaticity, regardless of their target English Language Teaching specialism, be it English for Specific or Academic Purposes, or General English courses.

H.Q. Tran (2017) states that idiom learning and teaching has indeed gained a lot of popularity in English learning context, therefore the assessment of how well the learners actually use idioms is a growing trend. This observation is supported by Oakey (2020) according to whom, the central role of phraseology in language in general and in academic context in particular has been revealed in the recent years by an increasing adoption of corpus techniques by language scholars. Although the realization of the fact that academic discourse is the right place for figurative language seems to be gaining ground, the corpora-based research into the actual quantity of idioms *per se* used in academic domain – both spoken and written – remains fairly scarce. Among the studies relevant for the present research one could cite the work by Simpson and Mendis (2003), who discussed the corpus-based approach to researching and teaching idioms by drawing on the texts contained in the Michigan Corpus of Academic Spoken English (MICASE), and Miller (2020), who aims to discover whether idioms indeed occur in academic discourse and seeks to identify the most frequently used items in the spoken and written texts of the British corpus of academic English (BASE).

One of the reasons for the lack of fundamental research that would delve into the amount of idiom usage in an academic context may be the general confusion over the terminology in the domain of formulaic language. In J. Miller's words, "One person's 'idiom' may be another person's 'phraseological unit'" (Miller, 2020). Idioms are indeed subject to various definitions and classifications: they could be included as a subcategory into broader fields of multiword units (Miller, 2020), recurring word sequences or lexical bundles (Shin, 2019); according to Per Snoder (2017), idioms are distinguished from phrasal verbs and collocations but all the three make up formulaic sequences; in her definition Mona Baker (2017) stresses the degree of fixedness in idioms and defines such collocations as "frozen patterns of the language that allow little or no variation in form" (p.67); on the other hand, Gillian Lazar (2003) does not distinguish between idioms and metaphors and maintains that these forms constitute "figurative or metaphorical language" (p. 1). Similarly, Rosamund Moon (1998) equals metaphors and idioms but argues against the notion of fixedness, observing that most idioms are in fact subject to variation, provided some trace of their canonical form is detectable. In the light of the above, several studies that did analyse the "idiomaticity" of the university students' academic writing are not directly comparable with the present research, as in fact they covered a wider field of "multiword units", which include recurring lexical sequences other than just idioms (e.g. Ädel & Erman, 2012; or Shin, 2019).

Although for the purposes of identifying idioms in the students' writing, my research goes by the definition of the idiom proposed by Miller (2020): "an idiom is a multiword expression (more than one word in length), which is reasonably fixed syntactically, figurative, and, to a greater or lesser extent, opaque", the overall approach of the article adheres to the vision of idioms as formulated by Lazar (2003), who views idiomatic expressions as part of a wider notion of metaphorical language.

Another issue that underlies a corpora-based study of academic discourse is the variety of types of academic texts produced by different categories of authors, which contributes to the difficulty of classification in this field (e.g. native vs nonnative speakers, novice vs expert writers, university writing vs published articles, etc.). As Y.K. Shin (2019) emphasizes, a lot of recent studies that examined the use of formulaic language in the academic context did not distinguish between, for example, university assignments and published texts. Therefore, the findings of such research "may blur the differences due to the characteristics of the groups and the confounding influences of register differences" (Shin, 2019, p.1). Accounting for this aspect, the comparative analysis presented in this paper focuses exclusively on university writing (not including published texts) and highlights the differences in the frequency of idiom usage considering the native speaker/ non-native speaker characteristic of the learners.

To sum up, the use of figurative language is currently viewed as an inherent feature of academic discourse, a tool which can perform various functions in the construction of academic texts. Although metaphorical expressions have been discussed in numerous studies, the investigations that would address the actual numbers of idiomatic multiword units employed in AW – and which would be particulalrly relevant for my

research – have remained quite scarce, a probable reason for that being the overall confusion over the definitions and classifications that the domain of figurative language has traditionally been subject to. The idiomaticity of the AW done in English by Ukrainian students has also remained largely understudied, in terms of both qualitative and quantitave research. The lack of such investigations opens up a range of exploration perspectives in this area, which could eventually lead to enhancing the quality of teaching EAP to Ukrainian students.

Methodology

Participants: The written work, analysed in this paper, was submitted by two groups of Taras Shevchenko National University of Kyiv students who specialise in philosophy. Group 1 is a group of third year students, which comprises 11 female and 6 male learners (n=17), Group 2 is a group of second year students, made up of 14 female and 5 male learners (n=19), both groups (total n=36) are of B1+/B2 level of English according to CEFR. The groups were selected for my research because of 1) the proximity of their level of English and their university studies background, which contributed to the objectiveness of their results interpretation; 2) a fairly large number of students in the groups, which provided me with broader sample material; and 3) a friendly rapport established with the groups, which led me to believe that the students would be willing to give their consent to participate in the study.

Ethical considerations of the study. At the end of the semester the students were informed of my intention to use the tests they turned in for the purposes of my investigation. To ensure that the validity of the research would not be questioned, the potential participants were advised about the purpose and procedure of my study. I did not disclose my plans to the learners before assigning the tests to them to avoid possible effect of such prior knowledge on the outcomes of my experiment. The students were advised that their names would not be disclosed in the paper, and they were free not to give their consent with no further academic consequences. All the learners gave their oral consent to participate in the research. The study was conducted based on the objective assessment of the written work handed in by the students, with the uniform criteria applied to all the submitted tests. There were no participants specially selected for my experiment, which ensured the objectivity of my investigation and the representativeness of the sample.

Instruments and Procedure: The written work that features in the article is part of the module tests submitted by the two groups and is subject to the analysis in respect to the number of idiomatic formulae employed by the students in their texts. The *quantitative method* was used to calculate the number of target lexical items in the learners' written output: the multiword units that fell under the definition of Miller (2020), demonstrating a degree of fixedness, figurativeness, and opaqueness, were identified in the learners' writing, and then their idiomaticity was double-checked in the Camrbidge dictionary (https://dictionary.cambridge.org). The number of idiomatic expressions was calculated in every submitted test and then its occurrence *per million words* was statistically analysed to compare it to the rate of the usage identified in the British Academic Spoken English (BASE) corpus and in Michigan Corpus of Academic Spoken English (MICASE); or its occurrence *per 10,000 words* was calculated to compare it against the rate identified in the University of Michigan corps of academic written texts (MICUSP). The *qualitative method* was used to assess the stylistic appropriateness and formal accuracy of the target vocabulary employed.

The module test (MT) comprised a written part which contained six philosophy-related questions, out of which the students had to choose four and write reflective answers of about 150 words each. Although at times the learners' answers would slip into a more informal register, overall the test was supposed to be written in a style adhering to the norms of academic discourse.

Group 1: The first MT was done by the third year students (Group 1) around midterm, with no idiomatic expressions explicitly covered in any lessons taught to this group prior to the test. The second MT was done closer to the end of the semester with two classes taught in the second half of the semester that discussed General English (GE) idioms and Academic English (AE) idioms.

The idioms picked up for the GE class comprised: *you can't have your cake and eat it, the game is worth the candles, to lose the thread, to break the mould, to pass the buck, to spill the beans.* The lesson plan included the task of guessing the meaning of the idiom by matching it with the possible definition, jigsaw reading in groups into the history of the origin of three of the idioms, and inventing in groups the history of the other three idioms, and finally comparing it to the real story behind them. At home the students were

asked to do an output task by picking up two or three idioms that a person particularly liked, write a small paragraph about their personal experience to illustrate it and send it to my email to get the feedback from me. About half of the group completed the output task.

The idioms addressed in the AE class were part of a more general discussion on the use in the academic discourse of the vocabulary which is generally believed to belong to a more informal register. In the lesson we looked into the phrasal verbs which are frequently encountered in scientific articles (e.g. *to center round, to focus on, to draw on, to point out, etc*.), as well as into some idioms that I came across in the real articles I read for my own research: *in the same vein, look at something through the lens of, the return on investment (*in the sense of the outcomes of an activity*), to get a grip on smth, to shed some light on smth, to give a picture of smth*. As a lead-in activity the students were asked to think what concepts could be primarily conveyed by idioms in academic discourse (i.e. the perspective from which a question under study is viewed; discovering/ revealing/ demonstrating/ realizing something, etc.; in other words, idioms act like discourse markers that add expression to the authorial voice). After that, six target idioms were presented to the students with one word missing in each, the learners then had to fill in the expressions with the right word chosen from the list of the missing words provided in the task. After filling in the gaps and discussing the meanings of the idioms, the students were given sample paragraphs from the articles with the target idioms missing from the text and had to restore the paragraph to its original form. At the final stage of this part of the class, the learners were asked why they think the idioms are used in academic discourse, what features they impart to the text that make them a valuable asset for a researcher. The students were given no output task as homework in this academic English class.

It should be noted that the original idea of offering the learners a gap fill task with choosing the right word to fill in the idiom from a multiple choice of words was dismissed given the findings cited by a number of researchers (Boers et al., 2014; Boers et al., 2017), according to which this type of exercise can lead to the undesirable learning of erroneous collocations and thus to the "unlearning" of idiomatic expressions, when students who initially produce the idiom correctly, can then replace the target word with the wrong one as a result of the multiple choice exercise they were subjected to.

Group 2 (Control Group) The group of second year students acted as a control group, with no classes focusing on figurative language that semester. Their written work used in my paper was the second MT they wrote at the end of the semester.

Results and Discussion

Results: Group 1, which comprised seventeen learners, turned in the total of sixteen tests – one student failed to submit their written work. In MT1, conducted in the middle of the term, three students in the group used the total of three expressions that could be attributed to idioms based on Miller's (2020) definition – *actions cannot be seen in black and white, to get the point across*, and *the truth in the last instance.* The last expression is also rather not an idiom characteristic of the English language but sounds more like a direct translation from Ukrainian or Russian. Despite its unnatural form, I still counted it as an instance of idiomatic language, as I was primarily interested not in the correctness of the usage as such but the very attempt to employ an idiomatic expression in university writing.

The second test written by the same group saw the growth in the number of students employing idioms from three to seven, with two learners using the maximum number of idioms in the two tests (3): both of them employed one idiom in the first test, and two in the second one (one GE, one AE). Another noteworthy fact is that in the second test the students did not use any idioms other than those discussed in the classes preceding the test. Out of the six idioms we covered in the GE class, the students used three: *you can't have your cake and eat it; the game is worth the candles; to break the mould;* out of the six from the AE class they used two: *through the lens, in the same vein.* In the texts of three students the former sounded as "through the lens", while one student used the "through the prism" version of the expression, which sounds closer to the student's L1 variation. For the results calculation both versions of the idiom were viewed as the same expression.

The most popular idioms encountered in the test proved to be those from the AE class: *through the lens/prism* used 4 times; and *in the same vein* 3 times.

As for the control group (Group 2), there were three idioms identified in the tests turned in by seventeen students: *to go with the flow, (people just) didn't buy it, at the end of the day.* The frequency of idiom use featured in the tests by Group 2 is comparable to that produced by Group 1 in their first test (3/17 vs 3/16).

The results of my findings are shown in Table 1:

Table 1.
Idiom use in the writing by Group 1 and Group 2

Idiom use	Group 1 MT1	Group 2 MT	TOTAL Gr 1 MT 1+ Gr 2 MT	Group 1 MT2
N of sts who used at least one idiom	3/ 16	3/ 17	6/33	7/16
Overall N of idioms used	3	3	6	5*
N per 1 millon words (pmw)	341	321	331	568
Max N by student	1	1	1	2
N of GE idioms	3	3	6	3
N of AE idioms	non-applicable (n/ a)	n/a	n/a	2*
N of idioms covered in class vs non covered	n/a	n/a	n/a	100%/ 0%
The most frequently used	--	--	--	Through the lens (4*) /in the same vein (3)

**Through the prism* was viewed as a version of *through the lens* idiom
Source: compiled by the author

A point of my interest was to compare the rate of idiom use in the AW of Ukrainian students with that of students of an English-speaking university.

If to estimate that one student's test contained on average 500-600 words, then we obtain the frequency of 6 idioms per 18,150 words (550 words by 33 sts) in the control AW of both groups, i.e. done with no idiomatic language taught prior to the test, which amounts to approximately 331 idioms per million words (pmw): 341 pmw in Group 1 and 321 pmw in Group 2. This outcome is comparable to the findings cited in Miller (2020): 327 idioms pmw identified in the British Academic Spoken English (BASE) corpus, and higher than the results recorded by Simpson and Mendis (2003): 260 pmw in Michigan Corpus of Academic Spoken English (MICASE). The frequency of 568 idioms pmw demonstrated in MT2 of Group 1 is not comparable to these findings as it was affected by the teaching of idiomatic language prior to the test.

For the purpose of assessing the individual idiom use I turned to the site of the University of Michigan Corpus of Upper-level Student Papers (MICUSP, 2009), which contains the corpus of 800 A grade papers (approximately 2.6 million words) of various kinds (essays, critique, reports, etc.) and across different disciplines. This site attracted me by its accessibility, the possibility of dividing writing into that produced by native and non-native speaker students (although the amount of writing by these two categories of students might not be identical), and the relative simplicity of search parameters. The idioms which were most frequently used by Ukrainian students were *through the lens* and *in the same vein*, discussed in the AE class. The search of their usage in MICUSP yielded the following results:

- *Through the lens* = 0.47 per 10,000 words, with the total of 10 times used in 9 papers (only one of these by a non-native speaker). The highest number of occurrences fall on the domain of education (0.18) and English (0.07). As for the Ukrainian learners, *through the lens* was used by four students in Group 1 ("through the prism" version of the idiom is included into the calculation), which yields 4 per roughly 9,000 words (4.45 per 10,000 words), or if we calculate the number of the students in both groups, this makes 4 instances per roughly 18,000 words. These results are much higher than those showcased by Michigan students (2.2 per 10,000 words vs 0.47 in Michigan).
- *In the same vein* = 0.15 per 10,000 words, all the instances registered are in the domains of education, English and nursing (out of the three, one instance belongs to a non-native speaker, i.e. although generally the rate of the usage of this idiom is lower than that of the previous one, the proportion of its usage by non-native speakers is higher than that in the previous one). In the test of the Ukrainian learners, *in the same vein* was employed by three students in Group 1, which yields 3 per roughly 9,000

words (3.33 per 10,000 words), or if we calculate the number of the students in both groups, this makes 3 instances per roughly 18,000 words. These results are much higher than those showcased by Michigan students (1.67 per 10,000 words vs 0.15 in Michigan).

These findings are displayed in Table 2.

Table 2.
Top two idioms used by Ukrainian sts vs their usage recorded in MICUSP (per 10,000 words)

Frequency	*Through the lens*	*In the same vein*
Group 1	4.45	3.33
Both groups	2.22	1.67
Michigan native speakers	0.41	0.09
Michigan non-natives	0.06	0.06
Michigan total	0.47	0.15

Source: compiled by the author

Discussion: One of the aims of my research was to discover if idiomatic language indeed occurs in the academic texts of Ukrainian university students, written in English, and if so, how the rate of idiomaticity correlates with that exhibited by the students of English speaking universities; another aim was to find out if the discussion of idiomatic expressions in the classroom affected the frequency of idiom use demonstrated by the learners.

In the written tests, submitted by the students, the number of figurative expressions, which fell under the category of idioms, was calculated in every test and then its occurrence per million words was analysed to compare it to the rate of the usage identified in the British Academic Spoken English (BASE) corpus and in Michigan Corpus of Academic Spoken English (MICASE); or its occurrence *per 10,000 words* was calculated to compare it against the rate identified in the University of Michigan corpus of academic written texts (MICUSP). Unfortunately, I could not find the research that would identify the general frequency of idiom usage in the corpus of academic written English, therefore only the individual idiom use could be compared against the statistics available for written academic texts.

My findings show that the students' writing indeed features both idioms and metaphors even in the tests done in the classes not preceded by explicit discussion of figurative language in the academic context: in such tests both groups employed three idioms per group (one of 16, the other of 17 students).

In the second module test, written by Group 1 after classes that addressed metaphorical language use, the learners used solely the idioms we had covered in the classroom: three out of six covered in the GE class, and two out of six from the AE class. The frequency of idiom use in MT 2, which turned out almost twice as high as that displayed by the students in control tests (568 idioms pmw vs 331 idiom pmw), appears to confirm the hypothesis that discussing idiomatic language in class does affect the learners' productive output, even when they are not explicitly asked to use the target vocabulary in their writing.

It cannot be stated with certainty why this particular number of idioms was used or why the rate of GE idioms usage was higher than that of the AE. I could only assume that the idioms the students chose are either close to the expressions that they have in their L1 in terms of concept and form, i.e. demonstrate a high degree of "congruency" (e.g. *through the lens/prism, in the same vein, the game is worth the candles),* or are based on a vivid image, which may prompt the idiom's easier recall (e.g. *break the mould, you can't have the cake and eat it*). These outcomes are in line with the findings cited by Peters (2016) and Snoder (2017), who maintain that congruency is a factor which affects the acquisition of formulaic sequences by learners, with incongruent collocations proving to be more difficult to learn than congruent ones. One of the reasons for non-usage of the rest of the idioms could be that they were not particularly suitable for the questions that the learners reflected on, or – in the case of the AE idioms – were more appropriate for a research paper rather than for this kind of reflective writing.

The strongest students, who tend to intentionally learn the vocabulary we discuss in class and often demonstrate their uptake in later lessons, predictably employed the most idioms in their writing. Out of the three students who used idioms in their first test, two used the highest number of idioms –two – in the second test as well. Interestingly, all the idioms in MT 2 occurred in the writing of seven students (less than

half the group), which might be interpreted as an evidence in support of Simpson and Mendis' (2003) observation, who argue that the use of idioms seems to be more a characteristic of an individual learner's idiolect than that of a certain linguistic or content-related field.

Apart from idioms, the second test of Group 1 featured a number of metaphors, e.g. "it's a life path I follow every day", or "art opens the veil of something bigger to us". Generally, the second test submitted by the group produces the impression of being more loaded with figurative language, which could also perhaps be attributed to the fact of having explicitly discussed idiomatic language in class and therefore raised the learners' awareness about the potential of its usage in university writing.

As for Group 2 (control group), there were three idioms identified in the tests turned in by seventeen students, the number comparable to that exhibited by Group 1 in the first test (3/16 students vs 3/17 students), with the difference that the idioms used by Group 1 belong rather to the neutral register, while Group 2's sound rather informal. The style of Group 2's writing resonates with Shin's (2019) observation that L2 student writers tend to rely on formulaic language typical of conversation more than native-speaker academic writers do.

Another remarkable finding is that a lot of students of the control group demonstrated the use of metaphors in their tests: 11 students out of 17 used at least one metaphor in their writing, with one student going as high as six. Most of them had to do with one of the most common metaphors underlying academic discourse – that of serving as a basis or origin for something: the words and phrases *foundation, footing, "fundament", stems from, roots of, cornerstone* featured highest on the list of the metaphors employed. The reason for it could also be that in the classroom we discussed on several occasions how important it is to enrich one's language with synonyms to the word "basis", which students tend to overuse in their speaking.

Surprisingly, even in the tests supposedly uninformed by previous learning of idiomatic language, the rate of its usage by Ukrainian students (331 idioms pmw) appeared to be higher than that cited by Miller (2020): 327 pmw; and Simpson & Mendis (2003): 260 idioms pmw. A somewhat higher rate of idiom usage in the control writing may be attributed to the fact that the AW, analysed in my research, belongs to the students of humanities who, according to Miller (2020), tend to employ a higher amount of figurative language in their productive output. The unnaturally high frequency of idiom use in MT2 of Group 1, both overall (568 idioms pmw) and that of individual idioms, might have been caused by the specific conditions affecting the AW, as the learners could have wanted to obtain higher marks for the tests due to the use of idiomatic language, which we had discussed in the classroom. At the same time the high frequency of individual idiom use seems to support the line of argument formulated by Simpson and Mendis (2003), who point out that, unlike non-native speaker's frequency of idiom usage, the rate of occurrence of any individual idiom in texts by native speakers is indeed quite rare and unpredictable, which is caused by a vast repertoire of idioms that native speakers possess.

Pedagogical Implications: The Ukrainian students who participated in my research displayed a higher rate of idiomatic language use than their American and British counterparts, which turned out to be the most unexpected finding of my study. At the same time, all the idiomatic expressions employed were encountered in the tests of the "top performers" of the groups, whereas more than half of Group 1 and over 3/4 of control group failed to use any idioms at all. Another important finding is that Ukrainian students – although they might be quite skilful at carrying across their overall idea – remain more often than not fairly insensitive towards the stylistic characteristics of the vocabulary they use, which was vividly demonstrated in the writing of the control group. Given these findings, it could be beneficial for students if explicit teaching of idiomatic language were included into their university AW courses, with special attention paid to discussing the stylistic features of the idiomatic expressions appropriate for academic discourse, and the functions that idioms can perform in academic texts. This could lead to raising the students' awareness of the conventions of constructing academic texts in English, and consequently to enhancing the quality of their AW.

Conclusions

Figurative language, which may appear to be not entirely in line with accurate and straightforward formulations of academic discourse, is worth discussing in AW classes to raise the learners' awareness of the potential of its use in the academic context. Although the most surprising finding of my research was that the Ukrainian students' frequency of idiom usage turned out higher than that of their American and

British colleagues, there still are many issues to be addressed by English instructors, when it comes to teaching AW courses to Ukrainian learners. For example, the fact that all the instances of idiomatic language occurrence were identified in the writing of fewer than half of students in the groups, with the rest of the learners having used no idioms at all; or the common unawareness of the register of the vocabulary the learners use and their tendency to slip into informal style, which disrupts the conventions of academic writing. Overall, despite the fact that an explicit or intentional way of teaching idioms may lead to a somewhat exaggerated way of employing them in the productive output, in the long run it is likely to benefit the learners both in terms of knowing the concrete idioms, suitable for the academic context, and generally of promoting the learners' acceptance of the fact that metaphorical language can function quite organically in academic discourse.

The present investigation was subject to certain limitations, among which the amount of the written output analysed for the purposes of my research. Although it could be concluded that Ukrainian students do use idiomatic formulae in their academic writing, done in English, the amount of writing that features in my study is too small to make any large scale conclusions about the actual frequency of idiom use by large numbers of Ukrainian students of various specialisations. Another limitation has to do with the level of English of the groups, whose tests were assessed, and with their specialism. Both groups are of B1+/ B2 level of English language proficiency, specialising in philosophy, and it could be assumed that they might employ metaphorical language more freely and more often than learners of a lower degree of proficiency or of different (e.g. technical) specialisations.

Therefore, the potential for future studies lies in broader research that would involve larger numbers of students of various specialisations and different levels of English proficiency to have a more objective picture of the specifics of their idiomatic language acquisition and use. On a more practical footing, further research is called for to investigate the most effective methods of facilitating the acquisition of idioms, i.e. holistic vs analytical approach, exposure spacing, etc. to enhance the learning gains. The potential findings of such studies can reveal the patterns of Ukrainian students' uptake and application of English figurative sequences in their texts, which in its turn will enable the EAP instructors to address the identified drawbacks in designing AW courses and consequently improve the quality of teaching AW to Ukrainian students.

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Collaboration with the enemy under the criminal law of Ukraine and other European states: comparative research

Співпраця з ворогом за кримінальним законодавством України та інших європейських держав: порівняльне дослідження

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Abstract

The paper provides criminal law interpretation of collaboration offenses in Ukraine and several other European countries. The study critically elaborates on the overlapping provisions in Ukraine's Criminal Code, specifically Articles 111 (treason), 111-1 (collaboration activity), and 111-2 (aiding the aggressor state), which create inconsistencies and hinder effective prosecution in the area of national security.

Using comparative, historical, and systemic analytical methods, the authors highlight the challenges in distinguishing between collaboration, treason, and other related crimes under Ukrainian law. The study contrasts these issues with the clearer frameworks established in some European countries like Lithuania and Estonia, where collaboration and treason are distinctly defined.

Анотація

У статті здійснено кримінально-правове трактування злочинів колабораціонізму в Україні та кількох інших європейських країнах. У дослідженні критично розглядаються положення Кримінального кодексу України, які дублюють один одного, а саме статті 111 (державна зрада), 111-1 (колабораціонізм) та 111-2 (пособництво державі-агресору), які створюють суперечності та перешкоджають ефективному переслідуванню у сфері злочинів. національна безпека.

Використовуючи порівняльний, історичний та системний аналітичні методи, автори висвітлюють проблеми, пов'язані з розмежуванням колабораціонізму, державної зради та інших пов'язаних злочинів згідно з українським законодавством. Дослідження порівнює ці проблеми з більш чіткими рамками,

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The authors propose reforms to Ukrainian criminal legislation, including removing Article 111-2 and clarifying the distinctions between treason and collaboration. The paper advocates for adopting specific provisions for less severe offenses, similar to European models, to ensure proportionality and coherence in criminal liability. The study highlights an important aspect observed in many European countries, where lawmakers distinguish a separate provision for "military treason" (serving in the armed forces of an enemy state) apart from general treason offenses. It has been established the sanctions for such actions are particularly severe. This underscores the urgency of removing any elements of such conduct from the privileged provision in Article 111-1 of the Criminal Code of Ukraine, titled "Collaborative Activity."

Keywords: criminal liability, treason, assistance to aggressor state, collaborative activity, national security, martial law.

встановленими в деяких європейських країнах, таких як Литва та Естонія, де колабораціонізм і державна зрада чітко визначені.
Автори пропонують реформи українського кримінального законодавства, зокрема вилучення статті 111-2 КК України, та уточнення відмінностей між державною зрадою та колабораціонізмом. Документ виступає за прийняття спеціальних положень щодо менш суворих правопорушень, подібних до європейських моделей, для забезпечення пропорційності та узгодженості кримінальної відповідальності.
Дослідження підкреслює важливий аспект, який спостерігається в багатьох європейських країнах, де законодавці виділяють окреме положення про «військову зраду» (службу в збройних силах ворожої держави) окремо від загальних злочинів державної зради. Встановлено, що санкції за такі дії є особливо суворими. Це підкреслює необхідність виключення будь-яких елементів такої поведінки з привілейованого положення статті 111-1 Кримінального кодексу України під назвою «Колабораційна діяльність».

Ключові слова: кримінальна відповідальність, державна зрада, сприяння державі-агресору, колабораціонізм, національна безпека, воєнний стан.

Introduction

Within the academic sciences of criminal law and criminology, the topic ofcollaboration as a specific offense refers to acts of cooperation with the enemy or occupying force, particularly during the period of war or occupation, in ways that harm one's own country or its citizens. It involves assisting or aligning with the adversary, often for personal gain, survival, or ideological alignment and is typically considered treasonous or subversive in its nature.

Historically, the concept of collaborative activities has been associated with actions that undermine national sovereignty and security. In the context of Ukraine, the ongoing conflict with Russia since 2014, and particularly the full-scale invasion in 2022, has brought the issue of collaboration into sharp focus. The war has exposed significant gaps and ambiguities in Ukraine's legal framework, particularly concerning the prosecution of individuals engaged in acts of collaboration, such as supporting occupation authorities, disseminating enemy propaganda, or aiding military operations of the aggressor state. This ongoing conflict has underscored the critical importance of a clear, comprehensive, and enforceable legal definition of collaboration that aligns with best European practices while addressing Ukraine's unique security challenges. The inclusion of collaboration offenses in Article 111-1 of the Criminal Code of Ukraine represents an important step forward.

While regulation of collaborationism is primarily governed by the national criminal laws of individual countries, international law also prohibits collaboration in the context of armed conflicts. Notably, the 1907 Hague Convention (IV) on the Laws and Customs of War on Land forbids collaboration with an enemy, including actions such as aiding the enemy, cooperating in hostilities, or providing other forms of assistance. Under international humanitarian law, depending on the nature, extent, and consequences of such acts, collaboration with an enemy can be prosecuted as a war crime or a crime against humanity (International Committee of the Red Cross, 1907).

However, the phenomenon of collaboration can not be examined through "black and white" lenses only. As a matter of fact, some individuals might collaborate under duress, coercion, or in an effort to mitigate harm caused to their communities. Thus, countries that are confronted with ongoing war conflicts on their territories often struggle with distinguishing between necessary cooperation and treacherous collaboration.

Understanding collaboration as a serious crime often requires a nuanced consideration of a combination of motives, circumstances, and the degree of harm caused to the national security or public welfare.

The academic aim of this paper is to examine approaches in the criminal law of Ukraine and other European countries to imposing liability for various forms of collaboration with the enemy, to compare such approaches, to identify their advantages and disadvantages, and, based on this, to develop proposals, which national legislators can use in the future to improve relevant criminal law provisions. As an important research tool, the method of legal comparison will be used extensively throughout this research paper.

Literature review

The issue of collaboration with the enemy remains a critical topic in modern criminal law scholarship, particularly in the context of national security, international law, and transitional justice. Ukrainian and other European scholars have researched this complex legal issue at length.

In particular, Ukrainian commentator Ye. Pysmenskyy writes that social and political changes in Ukraine, which took place in 2014 and are still underway require rejection of the established negative trends in the implementation of state policies in all areas, including the area of criminal law regulation. Due to a number of various circumstances, this area of public regulation remains particularly sensitive. "The urgent need for reforming it requires, among other things, moderation and caution in the usage of various criminal policy methods, careful and thorough analysis of the criminalization and decriminalization factors, and also compliance with specific conditions" (Pysmenskyy, 2016).

In her turn, N. Melnychenko underlines the fact that collaboration is, in the vast majority of cases, carried out on the sovereign territory under occupation by another state. According to Art. 42 of the Regulations on the Laws and Customs of War on Land of the Convention (IV) respecting the Laws and Customs of War on Land of 1907, a territory is recognized as being occupied if it is, in fact, under the authority (control) of the enemy army. The occupation regime extends only to the territory where such authority is established and is capable of performing its functions. More broadly, the rules for the behavior of the aggressor state and the interaction of the civilian population with the occupier in the occupied territory are regulated by the provisions of the Geneva Convention relative to the Protection of Civilian Persons in Time of War (Melnychenko, 2023).

According to some Ukrainian researchers, collaborationism, when described broadly as a criminal, constitutes a special form of treason, which consists of military, political, economic, administrative, cultural, informational, and media cooperation of a citizen of Ukraine with the aggressor state or its representatives, illegal armed formations created or supported by it (Orlov, 2022).

The works by the above-mentioned, as well as several other legal commentators on the topic of criminal liability for collaboration activities, will be discussed in the following text as well. At the same time, during the research phase of working on this paper we have observed that non-Ukrainian commentators, both members of European and American academic communities, have scarcely researched the criminal law phenomenon of collaboration with the enemy. This can be probably explained by the fact that since World War II, there have been no wars and related occupations on the scale comparable to the ongoing Russo-Ukrainian war.

However, Western researchers have paid much more attention to collaboration in other historical conflicts, such as the Vichy regime's collaboration with the enemy in France during World War II, and also treason legislation in different countries. Among such researchers, we can name G. Fletcher (1982), R. Dudai (2021), D. Hill and D. Whistler (2022) and some others.

Methodology

In the course of working on this paper, the following research methods have been used.

1. Comparative Method. It was extensively used to analyze and contrast the legal frameworks addressing collaboration offenses in Ukraine and various European countries. This method helped to identify differences and similarities to propose legislative improvements. For the record, legal comparison method is actively used to research various legal principles and legal provisions in today's globalized environment. The comparative method strengthened the study's recommendations by grounding them in proven international experiences, which enhances their practical applicability and credibility.
2. Historical Method. It examined the evolution of legal approaches to collaboration in Ukraine and other states, thus highlighting how historical context influences contemporary legislation. The historical method provided the authors with a foundation for understanding why legal ambiguities exist, reinforcing the urgency for targeted reforms.
3. Systematic Analytical Method. This method was utilized to evaluate the coherence and effectiveness of Ukrainian Criminal Code provisions, specifically Articles 111, 111-1, and 111-2, in addressing collaboration offenses. This method helped to identify overlaps, inconsistencies, and gaps within the legislative framework. The systematic analytical method ensured that the study's recommendations are not only grounded in comparative insights but are also tailored to improve legal clarity and functionality within Ukraine's unique context.

The chosen combination of the comparative, historical, and systematic analytical methods significantly enhances the depth, breadth, and rigor of the study by providing a multifaceted approach to understanding collaboration offenses under Ukrainian and European criminal law. This holistic approach, supported by the authors, strengthens the study's argument for legislative reforms by linking theoretical analysis with practical examples. It also dmonstrates the complexity of prosecuting collaboration offenses in hybrid and asymmetric conflicts, a critical issue in Ukraine's ongoing defense against aggression; balances the academic, pragmatic, and normative aspects of legal scholarship, making the findings relevant both for immediate policy-making and future research. Finally, the integration of these methods enhances the study's ability to provide actionable, well-founded, and contextually appropriate solutions for reforming Ukrainian criminal law on collaboration offenses.

Results and discussion

The occupation of part of the territory of Ukraine as a result of the invasion of the troops of the aggressor state has created a new social, economic and ideological situation in the occupied territories. In order to establish the governance over the occupied territories, new authorities are being created, which are not subject to Ukrainian legislation. Citizens of Ukraine who reside in the occupied territory partially work in authorities, participate in peaceful assemblies, public actions of the occupation administrations. In order to legally prosecute such citizens while working in the bodies of the occupation authorities, criminal liability for collaboration activities and some other types of crimes has been introduced into the Criminal Code of Ukraine (Pletnov & Kovalenko, 2023).

Today, legal regulation of the phenomenon of collaborationism is largely governed by the criminal laws of a particular country. However, international law also recognizes the inadmissibility of collaboration in the context of armed conflicts. Legal scholarship distinguishes among several common types of collaboration:

- Political collaboration – supporting or participating in the governance imposed by an enemy force, such as serving in administrative roles under occupation;
- Military collaboration – providing intelligence, aiding in military operations, or directly fighting alongside the enemy;
- Economic collaboration – supplying goods, services, or resources to the occupying power, especially if it strengthens their war efforts;
- Cultural collaboration – promoting the occupying power's ideology, culture, or propaganda (Pysmenskyy & Movchan, 2022).

Based on the specific legal frameworks in various jurisdictions, collaboration may be prosecuted as treason, espionage, or similar offenses against the national security.

A. Collaboration Activity as a Crime under Ukrainian Law: Theory and Adjudication

All of the above-mentioned forms of collaboration activities are currently addressed in Article 111-1, "Collaboration activity" of the Criminal Code of Ukraine, which was adopted on March 3, 2022, right after the start of the full-scale invasion by the Russian Federation. In particular, part 1 of this provision recognizes as a crime: public denial by a citizen of Ukraine of the armed aggression against Ukraine, establishment and confirmation of the temporary occupation of a part of the territory of Ukraine, or public calls by a citizen of Ukraine to support decisions and/or actions of the aggressor state, armed formations and/or occupation administration of the aggressor state, to cooperate with the aggressor state, armed formations and/or occupation administration of the aggressor state, to non-recognition of the extension of state sovereignty of Ukraine to the temporarily occupied territories of Ukraine (Verkhovna Rada of Ukraine, 2001). In comparison, other countries, which have not previously faced collaboration-related challenges have not included anti-collaboration provisions in their national criminal laws.

Historically, in Ukraine, the concept of "collaborationism" as a legal, political, and criminal phenomenon was first widely introduced in 2014 following Russia's annexation of Crimea and its establishment of effective control over parts of the Donetsk and Luhansk regions. Moreover, Russia's full-scale invasion in February 2022 further prompted Ukrainian lawmakers to criminalize "collaboration" explicitly. Today, this offense has many forms and overall contributes to the Russian war of aggression against Ukraine (Sullivan & Kamensky, 2024).

Among the first decisions adopted by the Parliament of Ukraine after the introduction of martial law was the addition to the Criminal Code of Ukraine, Art. 111-1 "Collaborative activity". Several other criminal provisions, including the offense of humanitarian aid embezzlement, have been put on the books in 2022.

When analyzing legal consequences of the above-mentioned legal decision, we believe that the recently adopted statute should be regarded as a "special" provision in relation to treason as the major offense under Art. 111 of the Criminal Code of Ukraine. Such approach fully corresponds to the social and legal nature of collaboration activities and is consistent with the results obtained by historical and legal sciences. Based on those research results, understanding of collaborationism is reduced to conscious, voluntary, and deliberate cooperation by a person with the enemy in his own interests and to the detriment of his country. Collaborative activity as a form of state treason is also evidenced by the place of the corresponding norm in the overall structure of the Criminal Code text.

In our opinion, the offense of collaborationism constitutes a privileged form of treason, thus providing for a more lenient and specific punishment compared to other acts, which constitute treason. As one Ukrainian commentator notes, such format makes it possible not only to properly differentiate criminal liability for committing state treason but also, given the delay of the legislative solution to this important issue, ensure the retroactive effect of the relevant criminal law norm in time (Pysmenskyy, 2020).

Despite all this, it should be kept in mind that the most important guarantee for the successful implementation of the corresponding idea should be the comprehensive legislative description of actions, liability for which is regulated within the "privileged" provision for collaborationism – that is, the deliberate definition of specific manifestations of state treason, which are significantly less dangerous than all others provided (directly or indirectly) by the general provision (Art. 111 of the Criminal Code of Ukraine) (Verkhovna Rada of Ukraine, 2001).

Unfortunately, even a brief analysis of the collaboration statute reveals no scientifically based approach to solving this issue. In particular, in the context of the above, the question arises: why did the legislator provide for liability in Part 7 of Art. 111-1 of the Criminal Code of Ukraine for such actions of a citizen of Ukraine as voluntarily holding a position in an illegal law enforcement agency established in the temporarily occupied territory (hereinafter – TOT) and participation in the armed formations of the aggressor state, mitigate the punishment for them? After all, we are talking about one specific form of high treason, such as siding with the enemy during an armed conflict. In Ukrainian legal literature, the latter is traditionally interpreted as providing by a citizen of Ukraine direct assistance to a state with which Ukraine is currently at war or in armed conflict, the manifestation of which, among other things, is recognized as *joining certain military, intelligence or security formations of the enemy state (police, punitive units)*. In other words, here we talk about actions directly provided for in Part 7 of the new Art. 111-1 of the Criminal Code of Ukraine (Melnyk & Khavronyuk, 2018).

As an example, the Dzerzhinsky District Court of the city of Kharkiv (Ukraine) held that during the period of time no later than June 2022, representatives of the occupying authorities in the city of Izyum (Izyum District, Kharkiv Region, Ukraine) established a subdivision of an illegal law enforcement agency, namely the so-called "Izyum Department of the People's Militia" at the Department of Internal Affairs of the Temporary Civil Administration of Kharkiv Region". Furthermore, the verdict indicates that Person-1, during the same period of time, voluntarily applied for a position at that illegal law enforcement body and was appointed to the position of criminal investigation officer. Later, during the period of time from June 25, 2022 to August 26, 2022, Person-1, while in the relevant position, performed the official duties assigned to him by the occupying power aimed at the functioning of the specified illegal so-called law enforcement body of the occupying power, namely: accepted applications and reports from citizens about the commission of domestic and property crimes, as well as conducted surveys of persons who applied with relevant applications. Considering the stated circumstances, the court found Person-1 guilty of committing a crime under Part 7 of Art. 111-1 of the Criminal Code of Ukraine (Dzerzhinsky District Court of Kharkiv, 2023).

In another criminal case, the district court also found the defendant Person-2 guilty of collaboration with the enemy. The court has established that Person-2, who previously held an official position in the local prosecutor's office of Ukraine, starting from March 2022, while being in the Bilovodsk township of the Starobilsky district of the Luhansk region and also having previously held a position, has agreed to the proposal of representatives of the occupation administration of the aggressor state, namely – the Russian Federation, and representatives of illegal armed formations of the so-called "Luhansk People's Republic", to occupy position in the unrecognized law enforcement agency "Belovodsky District Prosecutor's Office of the General Prosecutor's Office of the Luhansk People's Republic" and thus continued to work as a prosecutor (Shevchenkiv District Court of Chernivtsi, 2023).

Such cases raise a question: why should actions of such "law enforcement officers" be prosecuted based not under Part 2 of Art. 111, but under the "privileged" Part 7 of Art. 111-1 of the Criminal Code of Ukraine? Also, if this act is recognized by the Parliament as a less dangerous form of high treason (privileged offense), then we, as legal scholars, would like to know what exactly type of offenses should be considered more dangerous and punishable under Part 2 of Art. 111 of the Criminal Code of Ukraine?

Overall, Ukrainian courts have been busy adjudicating criminal cases of collaboration with the enemy and also other offenses against the national security of Ukraine.

As we have mentioned at the beginning of this paper, members of the Ukrainian Parliament did not limit themselves to adding Art. 111-1 to the Criminal Code of Ukraine. In their opinion, such a step was not enough to create a truly effective mechanism of criminal liability for various and, admittedly, multifaceted forms of cooperation with the enemy. This is the reason why on April 14, 2022, Ukrainian parliamentarians adopted (taking into account the proposals of the President of Ukraine) Law of Ukraine No 2198–IX "On amendments to the Criminal and Criminal Procedure Codes of Ukraine regarding the improvement of liability for collaborative activities and the application of preventive measures for committing crimes against the foundations of national and public security" (Law of Ukraine No 2198–IX, 2022). It has led to the emergence of yet another criminal law provision in the system of Section I of the Special Part of the Criminal Code of Ukraine aimed at regulating the liability of persons who committed acts to harm Ukraine – Art. 111-2 "Aiding the aggressor state."

However, starting with the legislative introduction of Art. 111-2 of the Criminal Code of Ukraine in its current version, the issue of distinguishing this norm from the provision of Art. 111 of the Criminal Code of Ukraine on treason has remained quite a challenge (Dudorov & Movchan, 2022).

In particular, it is presumed that such abstractly worded acts as "the implementation or support of the decisions and/or actions of the aggressor state committed with the aim of harming Ukraine" in the text of this criminal law provision, in fact, may well be considered high treason in the form of the same unspecified comprehensive encroachment, such as "providing a foreign state, a foreign organization or their representatives with assistance in carrying out subversive activities against Ukraine". The latter can also be recognized as virtually any act committed by a citizen of Ukraine on the grounds mentioned in Art. 111 of the Criminal Code of Ukraine, which harms the sovereignty, territorial integrity and inviolability, defense capability, state, economic or informational security of Ukraine.

Such approach has led to the fact that acts, which ate virtually identical in their meaning, can be recognized as:

- Implementation or support of the decisions of the aggressor state under Art. 111-2 of the Criminal Code of Ukraine, which is punishable by imprisonment for a term of "only" 10 to 12 years;
- Providing assistance to a foreign state in conducting subversive activities against Ukraine, which, under martial law, entails a much more severe punishment of imprisonment for a term of 15 years or life imprisonment with the confiscation of property.

As an example to the point, the Khortytskyi District Court of Zaporizhzhia has established that Person-3, while acting deliberately in the city of Tokmak, Polohi District, Zaporizhzhia Region, have assisted the aggressor state (the form of assistance) in carrying out subversive activities against Ukraine, supported the decisions and actions of the aggressor state in the implementation of educational standards of the Russian Federation at the TOT of Tokmak, Polohi District, Zaporizhzia Region, and also helped the occupying administration installed by the aggressor state to organize educational process and implement educational system based on the standards of the Russian Federation in educational institutions for children and young adults (Khortytsky District Court of Zaporizhzhia, 2023).

We want to raise the following question: why such "assistance in carrying out subversive activities against Ukraine," which, we would like to remind you once again, is directly indicated in Art. 111 of the Criminal Code of Ukraine, as one of the forms of high treason, has been recognized not as high treason but rather as assistance to the aggressor state? Why exactly the defendant here was not prosecuted for educational collaborationism under part 3 of Art. 111-1 of the Criminal Code of Ukraine?

We will now turn to the decision by the Vinnytsia City Court of the Vinnytsia Region, which has found Person-5 guilty under Art. 111 of the Criminal Code of Ukraine for voluntarily taking position of assistant prosecutor in the so-called "Prosecutor's Office of the Stanichno-Luhansk District of the Prosecutor General's Office of the LPR" (here the question arises again about part 7 of Art. 111-1 of the Criminal Code of Ukraine) and on April 13, 2022 held a meeting together with the so-called heads of educational institutions of the Stanichno-Luhansk district (Vinnytsia City Court of Vinnytsia Region, 2023).

In this regard, the following question can be raised once again: why the actions of a police officer who expelled Ukrainian citizens from Tokmak have been recognized as aiding the aggressor state, while the actions of the so-called prosecutor, who held a meeting with the so-called heads of educational institutions in the Stanychno-Luhansk district, were considered treason?

We believe that such situation, where virtually any behavior committed with the intent to harm Ukraine can be prosecuted under two (this is even without considering the Criminal Code provision on collaboration) separate provisions with significantly different sanctions, is unacceptable and, therefore, should be corrected as soon as possible. At the same time, one can only imagine how critical the situation would become if the original intentions of parliamentarians to refer to such purely abstract actions as "other voluntary interaction" and "any other cooperation" in Art. 111-2 of the Criminal Code were to be implemented.

In our opinion, when elaborating on ways to improve national criminal law in the discussed area, the Ukrainian Parliament should choose one of the following options:

1) Either to provide for only specific (not abstractly worded) types of the most dangerous, in their opinion, acts committed with the aim of harming Ukraine (for example, serving in the military formations of the aggressor state, espionage, and, if necessary, some others) in Art. 111 of the Criminal Code of Ukraine, while excluding the reference to the all-inclusive general "provision of assistance to a foreign state or their representatives, foreign organization or their representatives in conducting subversive activities against Ukraine" (the same applies to 'defection to the enemy') from it, all manifestations of which should be recognized as the less dangerous offense "aiding the aggressor state" and thus should be prosecuted under Art. 111-2 of the Criminal Code of Ukraine;
2) Or, on the contrary (as was done in Art. 111-1 of the Criminal Code of Ukraine), describe, within Art. 111-2 of the Criminal Code of Ukraine, on an exhaustive range of specific actions committed with the aim of harming Ukraine, which, according to the legislator, are less dangerous and should be recognized as aiding and abetting the aggressor state. At the same time, under the condition of the

implementation of such initiative, the general and unspecified "implementation or support of the decisions and/or actions of the aggressor state" should be excluded from this norm, while its manifestations should be recognized as treason in the form of "providing assistance to a foreign state, a foreign organization or their representatives in carrying out subversive activities against Ukraine" (or "switching to the side of the enemy") and, accordingly, qualify under Art. 111 of the Criminal Code of Ukraine;

3) However, and this is extremely important, the previous option will only become viable if a range of relevant, less socially dangerous offenses is identified – the one not addressed either by Art. 111 or by Art. 111-1 of the Criminal Code of Ukraine. At the same time, with regard to such an initiative, it should be stressed out:

   – Firstly, based on the analysis of Art. 111-2 of the Criminal Code of Ukraine, no such behavior has been detected so far, except holding positions in the illegal so-called state or municipal enterprises created on the TOT, related to the performance of organizational-managerial or administrative-economic functions), which could not be "painlessly" charged under the two above-mentioned provisions;
   – Secondly, the question arises: if such a type of act, which is not provided for even in the excessively casuistic Art. 111-1 of the Criminal Code of Ukraine, does exist (see the exception mentioned in the previous paragraph), would it not be easier to include this encroachment in the relevant provision on collaboration, rather than supplementing the Criminal Code of Ukraine with one more provision of unclear legal meaning?

4) Or, finally, for the most dangerous offenses committed with the intent to harm the state of Ukraine (e.g., siding with the enemy during an armed conflict, espionage) in a distinct *corpus delicti* while leaving other less dangerous acts within the general provision on treason and the Article on collaboration with its milder penalties.

B. European Models of Liability for Collaborative Actions: Distinct Approaches

Within the comparative analyses mode, the legislative model, under which dangerous offenses with the intent to harm the state are recognized in specific provisions with enhanced penalties while leaving all other less dangerous acts within the general criminal law provision on treason and the norm on collaboration with its milder penalties, has been "tested" in the texts of:

a) The Criminal Code of Croatia, which has a general provision on high treason and several provisions on service in the enemy armed forces, aiding the enemy (only Croatian citizen can be prosecuted), and espionage (any person can be prosecuted) (Articles 340, 343-344, 348 of the Croatian Criminal Code). Noteworthy are the provisions of Art. 342 "Prevention of Fighting the Enemy", which, although recognizing a Croatian citizen as the perpetrator, in part 2 contains a special clarification that for the purposes of the entire relevant Chapter 32 "Criminal Offenses against the Republic of Croatia", a foreigner residing in Croatia is also recognized a Croatian citizen (Republic of Croatia, 1997);
b) The Criminal Code of Romania, which has a general provision on treason (Art. 394, with a penalty of imprisonment for a term of 10 to 20 years), as well as separate Articles on treason by espionage (Art. 395) and treason in the form of waging hostilities against Romania by a Romanian citizen during the war, assisting the enemy in the form of bypassing the Romanian army, reporting the location of the Romanian armed forces, etc. (Art. 396, punishment - imprisonment for a term of 15 to 25 years or life imprisonment). In addition, liability for hostile acts against Romania committed by a foreigner or a stateless person is regulated separately (Art. 399) (Romanian Parliament, 2009).

As for the European experience in general (not only Romania and Croatia), the lack of a unified approach to this issue is self-evident, while criminal law of different countries contains:

– Either a single provision on high treason, which is virtually identical in content to the one provided for in Art. 111 of the Criminal Code of Ukraine (Art. 337 of the Criminal Code of Moldova (Parliament of the Republic of Moldova, 2002); Section 3 of Chapter 12 (Law № 39, 1889), etc.);
– Or a single provision called "actions against the state" or "assistance in subversive activities against the state" (sometimes also espionage) rather than treason. Within such provision: first, the acts that

should be criminalized by it are not specified (abstract method); second, the subject is general (Articles 80, 85 of the Criminal Code of Latvia (Latvijas Vēstnesis, 1998), Articles 127-128 of the Criminal Code of Poland (Polish Sejm, 1997), § 81-82 of the Criminal Code of Germany (Federal Office of Justice (1871), Articles 1, 5, 6, 7 of the Criminal Code of Sweden (any person can be prosecuted) (Swedish Parliament, 1962));

– Or a single provision on high treason, which recognizes such specific offenses as defection to the enemy in wartime or a period of armed conflict or terror or sabotage (guilty person – citizen of the country), and espionage (general subject) (Articles 100, 104 of the Criminal Code of Bulgaria, (UNHCR, 1968); § 311, 318 of the Criminal Code of Slovakia (Slovak National Council, 2005)).

Alternatively, in the criminal legislation of some countries, liability framework for switching to the enemy side has been prescribed within the limits of a separate provision, which exists alongside the prohibitions on treason and espionage (Articles 102, 108, 110-111 of the Criminal Code of the People's Republic of China (National People's Congress of the People's Republic of China, 1979), Articles 301, 303, 325 of the Criminal Code of Turkey – general subject (Grand National Assembly of Turkey, 2004), Articles 411-1, 411-2, 411-3, 411-4, 411-5, 411-6, 411-7, 411-8 of the Criminal Code of France (French Parliament, 1994). At the same time, we want to mention Art. 586 of the Spanish Criminal Code, in which, similar to the Croatian approach, it is noted that a foreigner can be recognized as a perpetrator of all relevant crimes. However, he must be sentenced to a punishment, which is one degree lower than the one to be imposed on a Spanish citizen.

The Criminal Code of Lithuania, along with the prohibition of espionage, contains a few general provisions on: a) high treason, which recognizes actions of a Lithuanian citizen who, in wartime or after the declaration of martial law, went over to the enemy or helped the enemy to act against the state, b) and aiding and abetting another state, as well as c) a separate provision on collaboration (Articles 117-120), and in the Czech Criminal Code – a provision on high treason, which recognizes terrorist acts, sabotage, terror, subversion of the Republic, espionage (general subject), as well as separate provisions on collaboration (general subject) and treason, i.e. service of a Czech citizen in the enemy armed forces (Articles 309, 316, 319-321) (Seimas of the Republic of Lithuania, 2000).

In the context of the possible correlation between liability of a citizen of the respective state and a foreigner (stateless person), the Estonian legislative experience is also of value to our research since the criminal law of this country has: a) an abstract rule on violent acts directed against Estonia – a general "offender" (Art. 231); b) an equally abstract provision on high treason, which recognizes non-violent acts or espionage committed by an Estonian citizen (Art. 232); c) special provisions on relevant non-violent acts of an alien and espionage committed by an alien (Articles 233-234); d) separately, a provision on the defection of an Estonian citizen to the enemy during the period of war or occupation of Estonia (Art. 234-1) (Riigi Teataja, 2001).

As a brief observation, the approaches by European legislators are far from being unified, which is hardly news to any alternative legal commentator.

Within the discussion part of our research, we would like to make the following point to summarize our brief analyses based on the scope of issues and the extent of criminal behavior prescribed in the collaboration provision. Quite a few issues are related to the text of Art. 111-1 and its practical implementation remain unresolved. For example, as a matter of pragmatic approach, it is worth comparing the elements of crimes established in Part 7 of Art. 111-1 and in Art. 260 ("Creation of unlawful paramilitary or armed groups") of the Criminal Code of Ukraine. Part 7 of Art. 111-1 provides for criminal liability for a specific form of collaborationism, such as the voluntary participation of a Ukrainian citizen in illegal armed groups formed on the temporarily occupied territory. In comparison, Art. 260 of the Criminal Code of Ukraine establishes criminal liability for the creation and participation in paramilitary or armed groups not provided for by the laws of Ukraine. At first glance, the mentioned elements of crimes provide for liability for the same actions – that is the creation of illegal military formations. However, those elements have certain differences, such as: 1) national security constitutes both the scope and goal of collaboration activities. In contrast, public security interests are affected by the crime provided for in Art. 260 of the Criminal Code of Ukraine; 2) Art. 260 of the Criminal Code establishes liability for the creation of illegal military formations during peacetime, while Part 7 of Art. 111-1 provides for criminal liability for participation in illegal armed groups during the occupation of part of the territory of Ukraine by an aggressor state.

Among the key distinguishing features between collaboration activities and the creation of illegal paramilitary formations is the territory (place) where this crime has been committed. Under real-life conditions, collaboration activities are possible only on the occupied territory. Thus, we share the scholarly position that the establishment of illegal armed formations in peacetime (Art. 260) and under conditions of occupation of part of Ukraine's territory during armed aggression (Art. 111-1) should be prosecuted based on different provisions of the Criminal Code of Ukraine (Pletnov & Kovalenko, 2023).

As our analyses has revealed, there is overlap among Articles 111 (treason), 111-1 (collaboration activity), and 111-2 (aiding the aggressor state) of Ukrainian Criminal Code. Offenses like aiding the enemy can be prosecuted under multiple provisions, leading to confusion and unequal application of penalties.

Also, collaboration under Article 111-1 overlaps with offenses such as creating illegal paramilitary formations (Article 260). We argue that such distinctions should be clearer, as collaboration typically occurs in occupied territories, while other crimes may occur in peacetime.

In contrast, some countries, like Lithuania and Estonia, differentiate treason, collaboration, and aiding the enemy more distinctly. European systems often provide for a "privileged" form of treason for less severe offenses or specific rules for foreign perpetrators, thus offering better clarity and proportionality in punishment.

Our discussion ultimately led to the call for Ukrainian lawmakers to reform the national Criminal Code in order to address ambiguities and learn how to prosecute collaboration offenses from the best European practices. Among various other resources in the hands of the government, legal education could also play a major role in educating Ukrainians on their key rights, freedoms and obligations when it comes to the priority issues of the national defense and national security (Myroshnychenko et al., 2024).

The overall effectiveness of the proposed reforms in combating collaboration depends on how well they balance clarity, fairness, and enforceability. Positive outcomes would include better-targeted prosecution of collaborationist activities and clearer deterrence mechanisms. However, careful consideration must be given to the risks of over-criminalization, enforcement challenges, and political interference. A well-structured and transparent reform could foster public confidence and legal clarity, allowing Ukraine to more effectively combat collaboration during occupation and in its broader fight against foreign aggression.

Conclusions

Based on the results of the comparison of relevant Ukrainian and other European approaches with regard to criminalizing collaboration, we have been able to formulate certain conclusions and observations.

Firstly, Lithuania is probably the only European country with three separate provisions in its criminal legislation, similar to those provided for in Articles 111, 111-1, 111-2 of the Criminal Code of Ukraine, on treason, collaboration, and aiding and abetting another state. However, unlike in Ukraine, Lithuanian legislators have clearly distinguished between those elements of crime, in particular, by pointing out that only actions committed in peacetime are punishable under the provision of aiding another state against Lithuania.

Secondly, none of the other European countries discussed in this paper has two separate general rules, similar to those provided for in Articles 111 and 111-2 of the Criminal Code of Ukraine, under which citizens of a country could be held criminally liable for actions committed to harm the state in wartime.

Thirdly, the perpetrator of this crime can be a citizen of Ukraine, a foreigner, or even a stateless person. However, holding foreigners accountable for such crimes is usually not a reason to create a separate legal provision for aiding an aggressor state. In many countries we have studied, this issue is addressed more thoroughly, which is reflected in: a) either the presence of separate provisions, which provide for the punishment of such acts (Estonia, Romania); or b) the assignment of foreigners to the circle of persons capable of bearing liability for treason (Slovenia, Croatia); or c) the inclusion of foreigners permanently residing in a certain country into the group of persons capable of bearing liability for treason and other crimes against national security in general. At the same time, such liability is less severe when compared to the one provided for state citizens (Spain, Croatia); or d) the unified liability framework for espionage elements in most countries, where any person can be recognized as a perpetrator.

Fourthly, in those countries, which criminal codes contain not only provisions on treason but also on collaborationism (Estonia, Lithuania, Czech Republic), there are no other general norms (in Estonia, liability is differentiated depending on whether the relevant actions are violent or non-violent), according to which individuals could be held liable for actions committed during a state of war (or armed conflict), while aimed at harming the state in a certain manner.

In our opinion, when taken together, the four outlined circumstances convincingly prove the need to exclude Article 111-2 of the Criminal Code of Ukraine from the system of current domestic criminal legislation.

One last aspect to which we would like to draw attention is that parliamentarians of many European countries distinguish a separate (from the provision on treason) prohibition dedicated to "military treason" (performing military service as a citizen of the state in the enemy armed forces). At the same time, sanctions for such actions are very severe. This once again underlines the need to exclude indications of the relevant behavior as quickly as possible in the privileged norm provided for in Art. 111-1 of the Criminal Code of Ukraine "Collaborative activity".

A significant area of future research would be to conduct detailed case studies on the practical application of collaboration laws in Ukraine, focusing on real-world instances where individuals have been charged under Articles 111, 111-1, and 260. Case studies could provide insights into the difficulties faced by law enforcement, the judiciary, and the legal professionals involved in prosecuting such crimes. These studies could examine the following aspects.

Judicial outcomes. How have courts interpreted collaboration charges in different contexts? Are there discrepancies in sentences, and if so, why do they occur?

Enforcement challenges. What practical issues have law enforcement agencies encountered when investigating collaboration cases? How have these challenges been addressed, and where do gaps still exist?

Defendant profiles. What are the backgrounds and circumstances of individuals accused of collaboration? Are there patterns related to coercion, socio-economic conditions, or geographic location that could help inform more effective legal strategies?

Such case studies could offer valuable lessons for improving the application of collaboration laws and might serve as a foundation for developing more nuanced and equitable legal practices.

Additionally, comparative legal analysis would be a fruitful avenue for understanding how Ukraine's legal framework on collaboration aligns with or diverges from practices in other conflict zones around the world. By examining how different countries prosecute collaboration, particularly in situations of occupation or foreign aggression, this research could help identify best practices and potential pitfalls. Comparative studies could focus on the following topics.

Eastern European Case Studies. Exploring the legal approaches of countries with similar historical contexts, such as Latvia, Estonia, and Lithuania, could provide insights into how these nations differentiate between treason, collaboration, and aiding the enemy. How have their legal frameworks evolved over time, especially in the post-Soviet period?

Conflict Areas in the Middle East and Africa. Studying collaboration laws in countries such as Syria, Iraq, or Somalia—where occupation, insurgency, and foreign intervention have created complex legal landscapes—could offer lessons on how to effectively prosecute collaboration and prevent the exploitation of legal ambiguities.

Post-War Societies. Investigating how countries like Bosnia and Herzegovina or Rwanda addressed collaboration during and after periods of armed conflict may highlight the importance of reconciliation mechanisms, the role of transitional justice, and how laws on collaboration can be applied in post-conflict societies to prevent future violence.

We believe that effective comparative studies along those lines would provide a broader context for understanding how collaboration is defined, prosecuted, and punished in different legal systems, potentially informing rational reforms in Ukraine.

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Evaluación de la sustentabilidad en los campus de una institución de educación superior mediante Proceso de Jerarquía Analítica AHP

Sustainability assessment on the campus of a higher education institution using the Analytical Hierarchy Process (AHP)

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Resumen

Las Instituciones de Educación Superior (IES) desempeñan un papel fundamental para implementar prácticas de desarrollo sustentable al impulsar el desarrollo de campus verdes. Esta implementación debe utilizar un enfoque sistémico que permita la definición de dimensiones representativas. Se han considerado y utilizado diferentes herramientas que permiten la evaluación con una visión integrada, así como incorporar componentes clave en la evaluación a través del Desarrollo de la Capacidad de Evaluación (DCE). El objetivo del estudio es evaluar y comparar la implementación del desarrollo sustentable que existe en los campus de una IES mexicana. El marco integra el Método Delphi para recolectar datos y el AHP para análisis de los datos, ambos métdos selccionaron criterios de sustentabilidad efectivos. Los resultados

Abstract

Higher Education Institutions (IES) play a fundamental role in implementing sustainable development practices by promoting the development of green campus. This implementation must use a systemic approach that allows the definition of representative dimensions. Different tools that allow evaluation with an integrated vision have been considered and used, as well as incorporating key components in the evaluation through the Evaluation Capacity Building (ECB). The objective of the study is to evaluate and compare the implementation of sustainable development that exists on the campus of a Mexican IES. The framework integrates the Delphi method to collect data and AHP for data analysis, both methods seals effective sustainability criteria.The results indicate the possibility of identifying and analyzing the sustainable activities in each campus

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indican la posibilidad de identificar y analizar las actividades sustentables en cada campus para gestionarlos e implementar nuevos criterios e indicadores, los atributos del DCE percibidos como importantes se desempeñaron convenientemente, mientras que los percibidos con menor importancia se identifican como deficientes en su desempeño, dentro de los hallazgos se encontró que el principal criterio para desarrollar sustentabilidad es el factor de gestión ambiental. El estudio espera contribuir al uso de herramientas de evaluación de la sustentabilidad como promotores para que las IES mejoren su desempeño sustentable y la práctica del DCE como agente innovador que impulse de manera continua el uso dichas evaluaciones.

Palabras clave: Sustentabilidad, Gestión de sustentabilidad, Instituciones de Educación Superior, Desarrollo de Capacidad de Evaluación, Proceso de Jerarquía Analítica.

to manage them and implement new criteria and indicators, the attributes of the ECB perceived as important were performed conveniently, while those perceived with less importance are identified as deficient in their performance, among the findings was found that the main criterion for developing sustainability is the environmental management factor. The study expects to contribute to the use of sustainability evaluation tools as promoters so that IES improve their sustainable performance and the practice of the ECB as an innovative agent that continuously promotes the use of these evaluations.

Keywords: Sustainability Management, Higher Education Institutions, Evaluation Capacity Buiding, Analytic Hierarchy Process.

Introducción

Las actividades humanas han ejercido una preocupación sobre el impacto en nuestro entorno natural, social y económico, lo que ha llevado a un señalamiento hacia las organizaciones y las Instituciones de Educación Superior (IES) por su responsabilidad, transparencia y participación de las partes interesadas (Daub, 2007).

La sociedad se está transformando en una posición activa en la cual solicita evidencias a las IES de su contribución a una sociedad sustentable, a su vez las instituciones tienen un genuino compromiso con sus propios grupos de interés, considerando las preocupaciones y demandas (Cooper & Owen, 2007).

La población mexicana que está inscrita en el nivel superior ha crecido en las últimas décadas, actualmente son 5.2 millones de estudiantes (SEP, 2023). Las IES se enfrentaron a una gran expansión de la demanda de recursos energéticos y de agua, con una problemática de un bajo rendimiento de las instalaciones, comportamientos no adecuados de la comunidad en el ámbito ambiental y una gestión institucional laxa de sus operaciones para la conservación de energía y agua. Por lo tanto, se espera que la aplicación de tecnologías verdes y la gestión aporten la conservación de energía en las IES (Chen et al., 2019).

La incorporación de la sustentabilidad a las IES se ha desarrollado en diversos estadios. La relación entre el Desarrollo Sustentable (DS) y la educación superior se identifica por tres fases. La primera fase se desarrolló en la década de los 70´s e inicio de los 80´s, en la cual se adoptó una posición nueva en las IES hacia el DS, la incorporación fue débil en la mayoría de las IES, únicamente hubo aceptación por los vanguardistas (Calder & Clugston, 2005).

La segunda fase tuvo su desarrollo a finales de los 80´s y principio de los años de 2010, en la cual se utilizaron varios medios que van desde conferencias, declaraciones e iniciativas con la finalidad de vincular el conocimiento y pensamiento sustentable con la educación (Lozano et al., 2013) (Alghamdi et al., 2017), lo que incentivo el movimiento del campus verde (Leal Filho & Brandli, 2016) (Tan et al., 2014).

La tercera fase integra el DS a procesos de planeación en la estructura y misión de la IES, realineandolos y rediseñándolos hacia la sustentabilidad (Leal Filho et al., 2019), los esfuerzos están enfocados hacia el futuro de la IES y la sociedad circundante generando oportunidades para la generación de redes de difusión del conocimiento de sustentabilidad y el impulso de transformaciones sociales del DS en las comunidades y regiones locales (Beynaghi et al., 2016). El diseño sostenible del campus universitario, para ser transmisible, necesita una planificación general que contemple los campus integrados como un todo (Abdullah, 2020). Actualmente varias universidades se inclinan por el desarrollo sustentable que se integre de manera sistémica con la finalidad de lograr una buena gestión.

Las IES son reconocidas como motores para el desarrollo de las sociedades sustentables (Stephens et al., 2008). Desde una visión sistémica, las IES son capaces de transformar la mentalidad y valores de los futuros lideres que tienen un papel clave en procesos de educación, negocios y política (Cortese, 2003). La sustentabilidad se ha posicionado como una estrategia institucional en las IES (Ceulemans et al., 2015) (Dumay, 2016), donde las IES deben promover la educación para el desarrollo sustentable (Mokski et al., 2023).

Para transformar a las IES se debe de realizar una gestión eficaz que permita realizar acciones sustentables como la formación de un ambiente humanístico, promoción de ideas verdes, participación de estudiantes y profesores, fortalecimiento de las currícula verde, generación de conocimiento científico y su divulgación, estilo de vida con bajas emisiones, entre otras (Chen et al., 2019). La creación de la conciencia social en instituciones educativas implica la formación de estudiantes con responsabilidad social y ejercicio de prácticas sustentables (Ivanchuk, Kakhiani, Hryboiedova, Bilychenko & Huzii, 2024). El nivel de sustentabilidad está definido por las diferentes características organizacionales en las IES, su avance es medido a través de sistemas de seguimiento y evaluación de la sustentabilidad (Rossa & Mischen, 2022).

La evaluación no tiene sentido si no ayuda a crear continuamente y mantener los procesos generales generando acciones sustentables para gestionar los recursos necesarios y su uso una rutina. Para ello es necesario que los resultados sean conocidos y se realicen las acciones de mejora. Parte fundamental es mejorar la comprensión de las partes interesadas de los conceptos y sus prácticas evaluativas, las IES han diseñado e implementado una variedad de estrategias para ayudar a sus miembros a aprender y participar en dichas prácticas (Clark, 2012).

La evaluación de la sustentabilidad ha sido reconocida como una piedra angular para lograr IES sustentables y ha habido muchas contribuciones destinadas a desarrollar modelos y herramientas que puedan ser útiles para este propósito (Dumay, 2016) (Shriberg, 2002). El marco de evaluación de sustentabilidad utiliza modelos para probar el nivel de sustentabilidad ambiental de una IES con la prioridad de identificar los atributos débiles que necesitan mejoras (Menon & Suresh, 2022).

Existen estrategias de cómo el desarrollo sustentable ha alcanzado avances, entre una amplia gama de áreas, entre algunas se encuentra la ecologización de currículo (Lozano, 2010), (Howlett et al., 2016), el uso de normas ambientales como la ISO 14001 (Disterheft et al., 2012), la aplicación de la evaluación y presentación del informe de sustentabilidad (Lozano, 2011), celebración de conferencias especializadas, asociaciones, redes y herramientas de evaluación (Alghamdi et al., 2017).

La medición de la sustentabilidad es un proceso complejo y desafiante para las IES, existen diversos trabajos que analizan herramientas de evaluación de sustentabilidad (HES) para que cada IES pueda conocer mejor cómo medir la sustentabilidad de diversas maneras. Las HES son un conjunto de instrumentos que apoyan a las IES a contar con procedimientos y métodos para medir el desarrollo sustentable, lo que permiten auditar, comparar y comunicar los esfuerzos (Shriberg, 2002).

Las reformas que se han implementado en México, han orientado a la participación de las IES en el monitoreo del uso de energía y modernización de instalaciones, lo que exige la necesidad de evaluar los efectos de los proyectos. La evaluación permite que los procesos de auditoría que realizan las instancias federales doten de información para formular regulaciones más específicas para los fines de la conservación de energía de la IES.

La situación en que se encuentra México, un sistema de evaluación de la sustentabilidad de las IES será un mecanismo que permita evaluar los logros de la construcción de una IES sustentable, comparar el desempeño de la sustentabilidad en la institución y sus diferentes campus, lo que consolidará a la IES a desarrollar sus capacidades de gestión verde.

En el presente artículo se revisaron y analizaron las herramientas de evaluación de sustentabilidad para las IES con una mirada global de las herramientas existentes en el mundo y sus dimensiones, también se desarrolló un sistema de evaluación de la sustentabilidad para las IES mexicanas, con la consideración del estado actual del desarrollo de las capacidades de evaluación de la sustentabilidad de los campus en México. Se aplico el método Delphi para el consenso de expertos y el método AHP para el análisis de decisión de criterios múltiples para evaluar el desempeño de la sustentabilidad de la IES mexicana y sus campus con el grado de desarrollo de sustentabilidad, con la finalidad de validar la viabilidad de esta herramienta.

Finalmente se presentan las discusiones y conclusiones sobre el uso de la herramienta de evaluación y las implicaciones del desarrollo de capacidades de las IES para realizar la evaluación de la sustentabilidad en IES mexicanas.

Revisión de literatura

Evaluación de la sustentabilidad en IES

El concepto de sustentabilidad se ha generalizado y aceptado ampliamente, como pilar sobre nociones del mantenimiento actual y preservación para las generaciones futuras (Alghamdi et al., 2017). Estos pilares construyen las ideas del desarrollo sustentable introduciendo una nueva forma de comprender la relación de la sociedad-naturaleza (Ruggerio, 2021).

Este interés por el medio ambiente y la sustentabilidad en las IES se destacó desde la década de los 70´s, el concepto de sustentabilidad se ha traducido en diversas acciones como declaraciones, marcos, herramientas y sistemas que permiten evaluar e informar sistemáticamente el progreso y compromisos de su desarrollo sustentable (Gamage & Sciulli, 2016) (Lozano, 2006a) (Shriberg, 2002).

En la evaluación participan diversas realidades, fines, escenarios, actores y herramientas, los enfoques de las evaluaciones varían sobre todo en función del paradigma utilizado, de la base democrática, de la función y del motivo, del ámbito científico con que está relacionada el objeto de la evaluación y su complejidad, de los recursos disponibles, entre otros.

Cada evaluación es, por tanto, única, porque se realiza en un marco y en una situación particular. Por lo que se debe de considerar dentro del desarrollo de la capacidad de evaluación la creación necesaria de condiciones marco en el ámbito legal, formativo y normativo (Boyle et al., 1999) (Preskill & Boyle, 2008). El término de capacidad de evaluación fue definido en la Conferencia de la Asociación de Evaluación Americana de 2000 (AEA), como “la capacidad de realizar una evaluación efectiva”, aceptando que debe cumplirse los estándares de la disciplina (Milstein & Cotton, 2000).

A lo largo del tiempo se han desarrollado debates a nivel internacional de la propiedad y efectividad de la cooperación del desarrollo de sistemas nacionales de monitoreo y evaluación como la Declaración de Paris de 2005 y Agenda de Acción Accra de 2008, las Naciones Unidas para el Desarrollo Sustentable estable la Agenda 2030 con la finalidad de que cada país monitoree y evalúe la implementación de los Objetivos de Desarrollo Sostenible (ODS), lo que implica fortalecer las capacidades de evaluación. Por parte, de la OCDE, mediante el Comité de Asistencia de Desarrollo (DAC) en el equipo de Tareas *Evalnet* considera como pilar de gobernabilidad al desarrollo de la capacidad de evaluación lo que implica su utilización para medir el proceso para lograr los ODS (Klier et al., 2022).

La capacidad de desarrollar marcos y procesos ayudan a la práctica de la evaluación (Milstein et al., 2002). La sustentabilidad como educación es el marco para facilitar una experiencia educativa transformadora, el enfoque de capacidad se posiciona exclusivamente para permitir el desarrollo de la sustentabilidad como educación, los actores de las IES que participan son los educadores asociados con la educación de la sustentabilidad e involucrados en el diseño curricular y el impacto de la alineación con el enfoque de capacidad, manejando de manera intencional y consiente la sustentabilidad como la educación y las expectativas incorporadas (Holdsworth & Thomas, 2020).

Las IES deben considerar su capacidad de evaluación para crear las condiciones marco sustentables. La evaluación de la sustentabilidad permite a las IES medir la sustentabilidad desde las acciones que identifican cuestiones importantes según Shriberg (2002), “son calculables y comparables; van más allá de la ecoeficiencia; miden el proceso y las motivaciones; y hacen hincapié en la comprensibilidad”. Para Naccarella et al. (2007), “el DCE consiste en proporcionar al personal habilidades y recursos para realizar evaluaciones rigurosas en organizaciones que fomentan una cultura de apoyo y permiten que la evaluación se convierta en rutina su práctica cotidiana”.

La revisión literaria permite identificar autores que investigaron a la sustentabilidad en IES desde la óptica del DCE, podemos citar los siguientes; Fleming & Easton (2010) quienes mencionan que las evaluaciones deben fortalecer el DCE dada la falta y mala calidad de evaluaciones en materia de educación ambiental; Chen (2017) menciona como los factores contextuales afectan la implementación del DCE en IES desde

las perspectivas de capacitación de receptores y proveedores; Wade & Kallemeyn (2020), proporcionan una investigación empírica sobre cómo el DCE impacta en la práctica de IES del desarrollo de la evaluación sostenible; Levine et al. (2013), evalúan estrategias para la construcción del desarrollo de capacidades de programas de investigación coordinados entre IES y los servicios de salud; Mahato et al. (2022), exponen como el DCE minimiza los impactos de barreras organizacionales en las IES como la dinámica del poder y recursos finitos, incorpora métodos cuantitativos y cualitativos como iniciativas de sinergía para el DCE y; Sutter et al. (2024), señalan cómo el perfeccionamiento de habilidades de estudiantes y egresados permite ampliar competencias adquiridas en la educación formal y puestas en práctica en el mundo real.

Herramientas de evaluación de la sustentabilidad en IES

La importancia de las herramientas de evaluación de la sustentabilidad para las IES ha evolucionado en las últimas cuatro décadas para lograr un futuro sustentable. Las herramientas ayudan a las IES a medir el nivel de sustentabilidad, para lo cual la IES debe tener la capacidad evaluativa de identificar situaciones prioritarias, obtener datos y registros históricos, mantener actualizados procesos e identificar motivaciones y generar un ambiente en el que sea claro y accesible el tema de sustentabilidad para todos los actores. No existe una única herramienta o indicador que mida la totalidad de los ámbitos de la capacidad evaluativa de la sustentabilidad en la IES.

La heterogeneidad de las IES impulsa que el uso de las herramientas de evaluación considere rubros de su desempeño como la educación e investigación, la gobernanza, las operaciones y la participación comunitaria (Sayed et al., 2013). La gobernanza de la sustentabilidad en las IES se basa en el fortalecimiento entre las orientaciones de aprendizaje organizacional y orientación holística cultural, midiendo la transversalidad de cuatro dimensiones organizacionales clave (responsabilidad, propósito, concepción y relevancia y alcance del cambio) para que las IES busquen el cambio hacia en DS (Niedlich et al., 2020).

A lo largo del tiempo se han desarrollado diversas herramientas para evaluar la sustentabilidad en las IES, para describir algunas de ellas se considera las más conocidas según la revisión de la literatura por la frecuencia, su uso para evaluar, comparar y realizar evaluaciones comparativas, uso de indicadores y la posibilidad de acceso a la información (Caeiro et al., 2020). Se seleccionaron 14 marcos con la relación de las dimensiones que utilizan diversas herramientas (Tabla 1).

Tabla 1.
Herramientas de evaluación de la sustentabilidad en la educación superior y sus dimensiones

Herramientas Dimensiones	**AISHE**	**ASSC**	**AUSP**	**BIQ-AUA**	**CITE AMB**	**DUK**	**ESDGC**	**GASU**	**SAQ**	**STARS**	**SUM**	**GMID**	**SLS**	**TUR**
Operaciones	x					x			x	x			x	
Académico										x				
Aprendizaje							x[2]					x[10]	x	
Educación	x	x[1]		x	x	x					x	x[10]		x
Investigación	x	x[1]	x	x	x	x	x[3]	x	x[6]		x	x	x[12]	x
Enseñanza			x				x[2]						x[12]	
Sociedad	x							x						
Identidad	x													
Gestión		x			x		x[4]							
Administración									x	x[7]				
Medio ambiente		x	x					x						x
Comunidad		x			x	x								
Organización			x											
Gobernabilidad				x									x[11]	
Impacto económico directo								x						
Comunicación				x										
Derechos humanos								x						
Responsabildad del product								x						
Planes de estudios								x	x					
Prácticas laborales y trabajo digno								x						

Liderazgo							x[5]			x[8]		x	x[11]	
Redes sociales												x		
Participación												x		
Alianzas							x				x[9]			
Facultad y personal									x					
Extensión y servicios									x					
Personal clave										x				
Oportunidades para estudiantes									x					
Misión y planificación									x					
Campus sustentable											x			
Difusión y colaboración											x			
NÚMERO DE CRITERIOS	5	4	4	4	4	4	5	8	8	5	4	5	4	3

Notas: AISHE - Assessment Instrument for Sustainability in Higher Education, ASSC - Assessment System for Sustainable Campus, AUSP - Evaluación de las políticas universitarias de sustentabilidad como facilitadoras para el desarrollo de los campus de excelencia internacional, BIQ-AUA - Alternative University Appraisal, CITE AMB - Network of Science, Technology, Innovation and Environmental Education in Iberoamerica, DUK - German Commission for UNESCO, ESDGC - Education for Sustainable Development and Global Citizenship, GASU - Graphical Assessment of Sustainability in Universities tool, STARS - Sustainability Tracking, Assessment & Rating System, SAQ – Sustainability Assessment Questionnaire, SUM - Sustainable University Model, GMID - Graz Model for Integrative Development, SLS - Sustainability Leadership Scorecard, TUR - Three Dimensional University Ranking

[1] Educación e Investigación estan definidos en un solo criterio, [2] Enseñanza y Aprendizaje estan definidos en un solo criterio, [3] Definen un solo criterio Investigación y monitoreo, [4] El criterio hace referencia unicamente a la Gestión Institucional, [5] Compromiso y liderazgo estan definidos en un solo criterio, [6] Investigación y becas estan definidos en un solo criterio, [7] Planeación y Aministración estan definidos en un solo criterio, [8] Innovación y liderazgo estan en un solo indicador, [9] Difusión y colaboración estan definidos en un solo criterio, [10] Educación y Aprendizaje estan definidos en un solo criterio, [11] Liderazgo y gobernanza estan definidos en un solo criterio y [12] Docencia e investigación estan definidos en un solo criterio.

Fuente: Recopilación de los autores

La evolución de las nuevas herramientas de evaluación varía dependiendo cómo cada IES defina su propósito, alcance y función lo que le dará la robustez en el desarrollo de sus capacidades de evaluación (Shriberg, 2002). También debemos enfatizar que el impacto de los métodos depende de la flexibilidad y acceso a la información.

Las herramientas de evaluación comparten estructuras parecidas, niveles de jerarquía, criterios e indicadores. En la investigación de Alghamdi et al. (2017), realizaron un análisis comparativo de 12 marcos analizados (SAQ, GASU, SUM, UEMS, AISHE, BIQ-AUA, USAT, Green Plan, SCAS, AMAS, STARS y GM) que contienen 503 indicadores, encontraron que las dimensiones se distribuyen de la siguiente manera entorno (34 por ciento), academia (25 por ciento), gestión (23 por ciento), participación (17 por ciento) e innovación (1 por ciento).

El enfoque de evaluaciones que se basan en indicadores nos acerca a conocer el desempeño general y poder medir y comparar, resultando ser evaluaciones objetivas con un mayor nivel de transparencia y consistencia lo que permite tomar decisiones con un número mayor elementos-(Lozano, 2006b).

En las últimas cuatro décadas, se han identificado fortalezas y debilidades en los sistemas de evaluación de sustentabilidad por indicadores. Los desafíos que se encuentran en el uso de indicadores es la necesidad de establecer marcos claros, simples y robustos, los autores han investigado sobre gestiones que fortalecen a los sistemas de evaluación por indicadores, encontramos que puede ser una poderosa herramienta de soporte de decisiones que fomentan el desarrollo sostenible la manera de presentar los indicadores y que sean incluyentes con los actores que participan en el proceso de indicadores (Gibson, 2013), falta el marco conceptual para el desarrollo de indicadores que deben ser considerados en la selección de indicadores relevantes para la sustentabilidad y vigilar la implementación (Hák et al., 2016) (Mori & Christodoulou, 2012) (Turcu, 2013), de hecho en la etapa de selección causa complejidad e ineficacia al sistema de evaluación la existencia de un gran número de criterios (Cloquell Ballester et al., 2006) (Donnelly et al., 2007) y en las etapas de desarrollo y selección los usuarios finales y las partes interesadas deben probar (Mascarenhas et al., 2015) (Verma & Raghubanshi, 2018).

Referente a la evaluación de la sustentabilidad existen controversias y debates, desde la óptica que la sustentabilidad se oriento en la relación de la sobrepoblación y la escasez de recursos, dejando a la evaluación a justificar la existencia de los programas una vez finalizado su financiamiento inicial;

actualmente con la crisis del cambio climático, la sustentabilidad es una prioridad y su evaluación es vista como un procedimiento directo para la toma de decisiones.

Las evaluaciones de la sustentabilidad han registrado programas exitosos, sin embargo, han demostrado que tienen problemas para mantener los impactos deseados, se ha requerido evaluar su implementación y resultados durante periodos prolongados. El realizar una evaluación de impacto para conocer a través del tiempo la efectividad del programa considerando las cambiantes condiciones es realmente costosa (Kamijo & Haung, 2016). Otro punto es la complejidad de evaluar impactos entre las interacciones con sistemas dependiendo el marco seleccionado (Wu & Ma, 2019). El marco conceptual varía dependiendo de los elementos, que pueden seleccionarse tres, cuatro o cinco elementos, entre los que se encuentran el medio ambiente, la economía, lo social, lo institucional y la cultura, la definición del marco marca la asignación de recursos (Julnes, 2019).

La sustentabilidad y la evaluación de la sustentabilidad son analizadas en términos de procesos contra los resultados, en términos de procesos vistos como sistemas que interactúan con otros sistemas. El enfoque en el proceso permite disminuir la importancia de los resultados e impactos, más bien con la evaluación sistemática de los resultados e impactos que la evaluación puede contribuir a mejorar la gestión de los procesos.

Otro desafío es orientarse a los aspectos técnicos para apoyar la sustentabilidad, y abandonar el grado en que los programas de sustentabilidad son beneficiosos para la comunidad (Mischen et al., 2019). Los objetivos de desarrollo deben ser determinados por cada generación, lo que lleva al desafío que los evaluadores sirvan al interés público, desde la óptica táctica los evaluadores tendrán el reto de apoyar a los interesados a ubicar las compensaciones entre los sistemas ecológicos, sociales y económicos, y con una óptica estratégica los evaluadores enfrentan las acciones que orientan la visión a largo plazo.

Los paradigmas pueden priorizar diferentes intereses, el paradigma denominado “ecológico superficial” prioriza el desarrollo económico, con una mínima degradación ambiental y social y el paradigma “verde profundo” el cual prioriza el medio ambiente y la cohesión social con respeto a las ganancias económicas. El debate es la selección del paradigma permita la compensación de la sustentabilidad entre satisfacer las necesidades actuales contra las futuras.

El presente estudio analiza cómo la sustentabilidad se ha manejado a través de acciones como declaraciones, marcos, herramientas y sistemas con el propósito de evaluar e informar sistemáticamente el progreso y compromisos del DS de las IES. En la literatura se plasmó que la evaluación está definida por diversas realidades, fines, escenarios, actores y herramientas. Las IES deben definir la función en la que deben evaluarse considerando entre otros su objetivo, complejidad y recursos existentes, lo que definirá la elección de la herramienta de evaluación a utilizar. La evaluación se lleva a través de las etapas de desarrollo, selección e implementación, realizando un análisis crítico para el estado de arte de sustentabilidad se puede observar que mientras para Gibson la efectividad de la toma de decisiones del sistema de evaluación está definido en la manera en cómo participan los actores en el proceso de indicadores; para Hák et al., Mori & Christodoulou y Turcu falta el marco conceptual para el desarrollo de indicadores; para Mascarenhas et. al. y Verma y Raghubanshi lo critico está en la etapa de desarrollo y selección; para Cloquell et al. (2006) y Donnelly et al. (2007) está en la complejidad de la selección debido a un número grande de indicadores. Sin embargo, también podemos observar que no se puede definir la complejidad de una manera tan simple y para poder analizar desde otra perspectiva es que utilizamos la teoría general de sistemas, que se encarga de una integración del mayor número de variables consideradas por los autores enunciados y de herramientas multicriterio como el AHP que permite jerarquizar los criterios asociados a los parámetros considerados.

Se reconoce que cada evaluación es única y se define un marco y situación particular para realizarla. Se considera el DCE para la creación de dichas condiciones marco esta desde el ámbito legal, formativo y normativo. Desde el punto de procesos fortalece las etapas de desarrollo, selección e implementación y desde la óptica de su utilización se debe generar marcos claros, simples, robustos para el adecuado manejo de los indicadores. Entre los diversos autores consultados en relación a la sustentabilidad en las IES con óptica en DCE se encontró que Fleming y Easton manifiestan la falta de evaluación y su mala calidad; Chen enfatiza problemas en la etapa de implementación del DCE; Wade y Kallemeyn manifiesta los beneficios del DCE en la etapa de desarrollo; Levine et. al. evaluan estrategias para fortalecer el DCE en programas de investigación; Mahato et al., recomienda sinergia entre la gobernabilidad y el DCE; Sutter et al., (2024)

señalan el perfeccionamiento de habilidades adquiridas entre las competencias de la educación formal y las experiencias de la vida real. La evaluación es incongruente si no es capaz de crear y mantener procesos que generan acciones sustentables para gestionar recursos y llevarla su práctica a un hábito. El presente análisis está definido en términos de procesos con una visión sistémica que permite disminuir la importancia de los resultados aislados y puede contribuir a mejorar la gestión de los procesos sustentables.

Finalmente, entre los debates de la evaluación de la sustentabilidad la revisión bibliográfica apunta que existen problemas en los programas, entre ellos mantener los impactos deseados por lo que se requiere evaluar su implementación, debe realizarse una evaluación de impacto para medir la efectividad de los resultados por periodos prolongados, se aconseja seleccionar de 3 a 5 criterios, así disminuir el número de indicadores, dadas las interacciones entre los sistemas. De la misma manera, en aspectos técnicos se encuentran las siguientes consideraciones: definir el grado en que los programas benefician a la comunidad; reflexionar que los objetivos de DS se determinan por cada generación; valorar que los evaluadores deben compensar entre los sistemas con óptica a largo plazo; priorizar entre paradigmas como "ecológico superficial" o "verde profundo".

Metodología

Para identificar las barreras de la evaluación de la sustentabilidad se propone un marco con los métodos Delphi y AHP (Alshehri et al., 2015) (Kim et al., 2013) (Karam et al., 2021) (Van Nguyen et al., 2023) (Zhang & Lam, 2019). La técnica Delphi es aplicada para consultar a expertos en un tema específico y poder consensuar las ideas y opiniones sobre un tema específico, utilizando un cuestionario estructurado que ayuda a enfocarse en el problema (Min, 2016). La técnica AHP es el proceso de jerarquía analítica en el que se establece las prioridades de un marco establecido (Alshehri et al., 2015).

En este estudio, el método Delphi se utiliza para desarrollar el modelo del sistema de sustentabilidad de los principales criterios y sus indicadores. Se utiliza un enfoque de empleo AHP para determinar lo crítico entre los criterios e indicadores de la implementación del modelo de sustentabilidad. Se determinaron los pasos en etapas, en la primera de planeo la encuesta, diseño del cuestionario y estructura del panel de expertos. En la segunda se seleccionaron criterios e indicadores a través del uso del método Delphi. En la última etapa para conocer la importancia de cada criterio e indicador, se utilizó el método AHP.

En la primera etapa comprende la planeación de encuestas, el diseño de encuestas y la estructura del panel de expertos. Bajo el objetivo de evaluar la sustentabilidad en las IES se revisó la literatura para encontrar un conjunto relevante de criterios e indicadores y clasificarlos bajo los principios que manejan las herramientas de evaluación de la sustentabilidad. Los criterios cayeron dentro de los límites del sistema de evaluación de la sustentabilidad de las IES.

Los cuestionarios se diseñaron para que los encuestados evaluaran la sustentabilidad en la IES definiendo criterios e indicadores. Antes de cerrar la encuesta se les solicito a los expertos emitieran observaciones que permitieron perfeccionar el trabajo.

La estructura del panel de expertos se conformó para poder reflejar los puntos de vista y opiniones. Se invitó a los expertos a participar en la encuesta que tenía experiencia en el campo de la sustentabilidad y otros temas sobre gestión de residuos, regulación ambiental y campus verde, que correspondía a los límites del sistema de la evaluación del estudio. Los expertos fueron seleccionados con diversa formación académica provenientes de las facultades de la institución a nivel nacional en áreas de ingeniería, física, matemáticas, nuevas tecnologías, ciencias médicas y biológicas, y sociales, así como una sólida experiencia laboral en el gobierno y la industria (Tabla 2).

Tabla 2.
Características del grupo de expertos (N)

Género	Hombre	16
	Femenino	8
Edad	<40	2
	40–50	8
	> 50	14
Antecedentes dominantes	Trabajador IES - posición administrativa	5
	Trabajador IES – profesor	10
	Trabajador IES – decisor	6
	Gobierno - Secretaría del Medio Ambiente	1
	Industria	2
Educación	Doctorado	8
	Maestría	3
	Licenciatura	13
Lugar de trabajo	Empleado del sector público	22
	Empleado del sector privado	1
	Empresario, trabajador por cuenta propia	1
Años de experiencia	10-15	2
	16–20	6
	>20	16
Nodos de colaboración*	Red de Medio Ambiente	21
	Red de Energía	12
	Red Universitaria de Cambio Climático	3
	Programa de Investigación en Cambio Climático	8
	Proyecto de la Red de Museos Ecológicos en México y Centroamérica	1

***** Existen participantes que colaboran en diferentes nodos

En la segunda etapa se obtuvieron los resultados por consenso, los pasos a realizar fue tener rondas de consulta, para lo cual se invitó a cada experto vía correo electrónico para sus respuestas, posteriormente el procesamiento estadístico es analizar el coeficiente de variación (CV) para las encuestas y la relación de validez del contenido (CVR), se valora detener encuestas adicionales cuando el valor de CV es menor de 0.5 y se estima un nivel adecuado de evaluación para CVR cuando el valor es mayor a 0.29.

$$CV = \frac{\text{Desviación estándar}}{Media} \times 100 \qquad (1)$$

$$CVR = \frac{N_e - \frac{N}{2}}{\frac{N}{2}} \qquad (2)$$

Donde: *CV* relación de la desviación estándar
CVR media

N_e número de expertos en encuestas que indican que un factor o elemento es esencial
N número total de expertos en encuestas.

Se encuestaron dos veces para determinar los criterios para priorizar la sustentabilidad en los campus de la IES. La determinación de indicadores se realizó con la consideración que existe un conjunto de más de 100 indicadores, los expertos decidieron que debía seleccionarse una serie de los mejores según los criterios, para lo cual deben cumplir las siguientes condiciones:

a) El tamaño del conjunto final, puede ser entre 20 a 25 indicadores.
b) El conjunto final debe contener tanta información como sea posible del conjunto inicial de indicadores.
c) Obtener diferentes conjuntos finales para cada número de indicadores finales.
d) Las diferentes soluciones deben ser óptimas.

Los 24 expertos participaron en la primera ronda de Delphi, los resultados se integraron en el cuestionario utilizado en la segunda ronda. Se les informó a los expertos de los resultados preliminares y de su posición para aceptar o reevaluar la encuesta. La participación en la segunda ronda de los 24 expertos permitió la selección de criterios e indicadores. Los resultados de CV y CVR de los criterios se muestran en la Tabla 3.

Tabla 3.
Resultados CV y CVR de los criterios de evaluación final

Criterio	CV	CVR
Estructura y gestión	0.30	0.83
Educación e investigación	0.21	0.92
Entorno y sociedad	0.38	0.75
Gestión y desempeño ambiental	0.00	1.00

Los criterios se seleccionaron con base en el principio de que son independientes entre sí, pero corresponden al objetivo de evaluar la sustentabilidad, se categorizaron en cuatro criterios y 17 indicadores. En la Figura 1 se muestra la estructura del modelo de jerarquía para la decisión de la gestión sustentable, en la cual se muestran los niveles de decisiones, el objetivo, los criterios e indicadores.

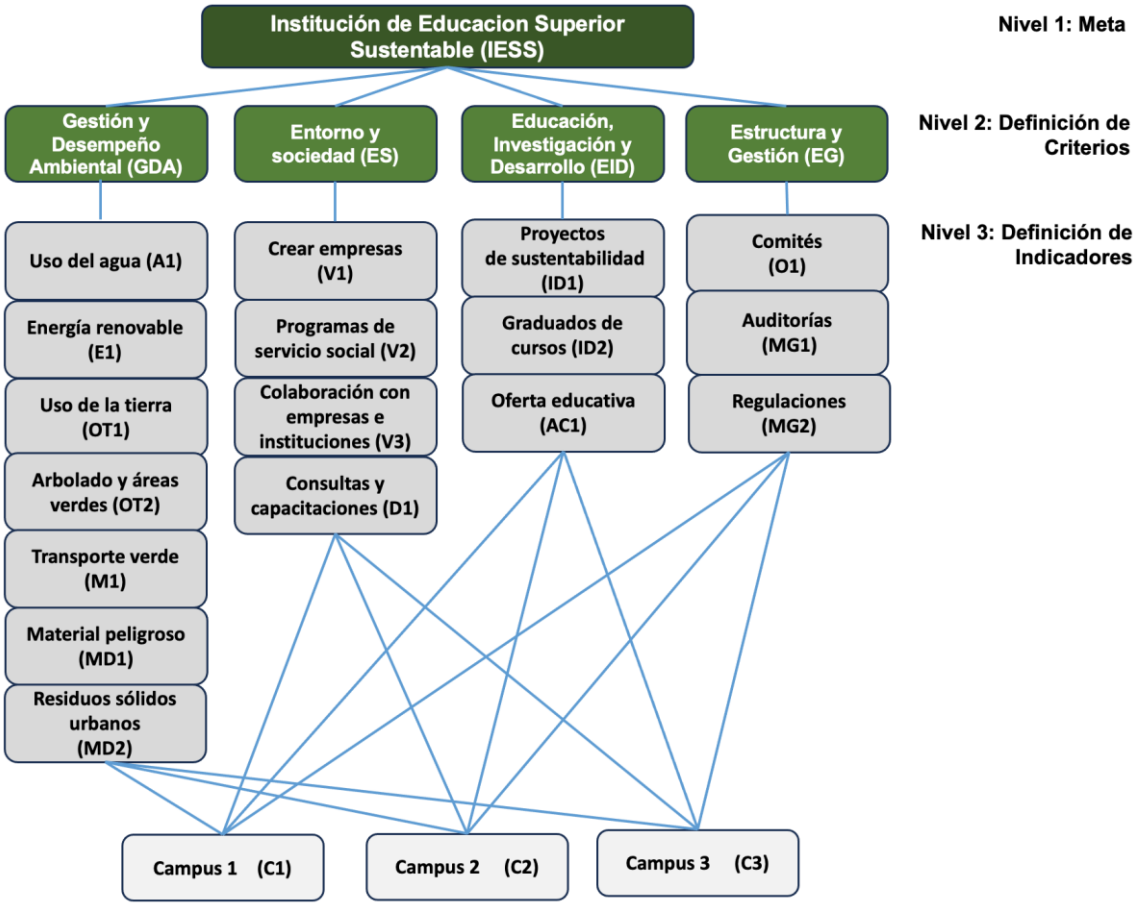

Figura 1. Modelo de jerarquía de decisión para el estudio APH para una Institución de Educación Superior Sustentable IESS

1. Estructura y Gestión

Las herramientas de evaluación consideran que las IES establecen su quehacer mediante la declaración de su misión, visión y objetivos establecen dentro de su gestión estructuras de incentivos y procesos organizacionales que les permita la toma de decisiones (Shuqin et al., 2019). Las IES requieren desarrollar

la sustentabilidad del campus con la robusta cooperación entre las áreas que permitan la cooperación de recursos humanos y de la academia, así como la integración de recursos materiales y financieros. El diseño de las estructuras implica gestión, reglas y regulaciones que permitan la transformación (Tan et al., 2014).

La estructura dentro de la IES que se encarga de las tareas concretas del trabajo de la construcción de un campus sustentable debe ser la Coordinación General de Sustentabilidad que da cumplimiento institucional de los compromisos establecidos para el desarrollo sustentable, permite la articulación entre la sociedad con la naturaleza (Alghamdi et al., 2017).

Se requiere diseñar desde la alta dirección la gestión de reglas, y regulaciones que se orienten a la conversión sobre energía y recursos (Alghamdi et al., 2017). Las IES deben diseñar e implementar mecanismos de gestión que incluyan planes a mediano y largo plazo que estén alineados a las normas y reglamentos, la creación de instancias sobre el uso de energía y agua deben regular las operaciones y efectuar auditorias como mecanismos de control y cumplimiento normativo para dar transparencia a sus operaciones y reportar el estado de eficacia (Shuqin et al., 2019). Las IES pueden apoyarse en la aplicación de la norma de gestión ambiental ISO 14001 (Alghamdi et al., 2017).

El análisis para la construcción de un sistema de evaluación arrojo para el Criterio I “Estructura y Gestión” los siguientes indicadores: I.1 Comités, I.2 Auditorías, y I.3 Regulaciones.

2. Educación, Investigación y Desarrollo

La educación e investigación son pilares en las IES ellas definen la cultura del campus, por ello evaluar el progreso y sus implicaciones permitirán establecer el rumbo de una educación e investigación científica verde. (Shuqin et al., 2019). La academia es un punto estratégico en las IES en las cuales se crea y consume conocimiento, esta cultura del campus nos permitirá impulsar una educación verde, se utilizará para evaluar el progreso y la implementación de la educación verde, la investigación y la formación de los recursos de la academia (Alghamdi et al., 2017).

La educación con perspectiva de sustentabilidad se usa con la finalidad de medir la eficacia de programas académicos y la existencia de estímulos orientados a la sustentabilidad. Las IES cuentan con una proporción de programas de licenciatura o posgrado en sustentabilidad con respecto del total de los programas, la proporción está en función de la situación de la definición de sus marcos educativos de sustentabilidad. En cuanto a la investigación la proporción debe estar en función de las políticas y logros que tengan en relación de la investigación en las áreas de sustentabilidad (Alghamdi et al., 2017).

La educación verde establece que las IES deben contar con cursos y programas orientados a la sustentabilidad para lo cual las IES deben de contar con las instalaciones, así como de los estímulos que permitan reforzar la gestión. (Shuqin et al., 2019). La formación de recursos es vital por lo que la proporción de estudiantes en cursos en sustentabilidad que se oferta en los diferentes niveles, de pregado y grado, respecto de la matrícula total, son indicadores que su programación está definida de conformidad con los objetivos que se han establecido a nivel institucional. (Shuqin et al., 2019).

La investigación en áreas de la sustentabilidad estable su gestión en función de los logros y las políticas que se establece para apoyar la investigación verde. Para evaluar los progresos se tiene la proporción de proyectos de investigación en sustentabilidad respecto del total de los proyectos, los valores son diversos dependiendo de lo programático presupuestal de las IES (Shuqin et al., 2019).

Otra de las acciones es la capacitación, dentro de las cuales puede desarrollarse seminarios, concursos u otras actividades de promoción de un campus sustentable para atraer la atención a la institución y la financiación del gobierno (Shuqin et al., 2019). Las IES requieren crear atmosferas de campus sustentables lo que implica iniciativas de capacitación, cursos, seminarios entre otras para promocionar actividades que puedan crear atención y financiación en temas de sustentabilidad, así como la creación de asociaciones, concursos y redes que permitan comprender las iniciativas actuales en relación a las humanidades verdes (Alghamdi et al., 2017).

El análisis para la construcción de un sistema de evaluación arrojo para el Criterio II “Educación, Investigación y Desarrollo” los siguientes indicadores: II.1 Proyectos de sustentabilidad, II.2 Graduados de curso, y II.3 Oferta educativa.

3. Gestión y Desempeño Ambiental

Las IES han desarrollado proyectos de ahorro de energía y recursos, lo que implica la transformación de edificios con enfoque energético, de suministro de agua y manejo de tóxicos, con la finalidad de modernizar aparatos que permitan el ahorro de agua, iluminación de bajo consumo, trasporte verde (Alghamdi et al., 2017).

Las IES deben establecer controles que permitan conocer la tasa de ahorro de energía con respecto del total de energía consumida; cantidad de agua que se consume y evaluar el efecto de dispositivos ahorradores, así como un seguimiento en los principales espacios como baños, espacios deportivos y comedores; respecto a los suelos debe reducirse la superficie edificable para conservar áreas verdes; en cuanto a residuos podemos aspirar a aumentar y promover el compostaje, reducir materiales de papel, aumentar el reciclaje de residuos electrónicos así como el correcto manejo de residuos peligrosos (Alghamdi et al., 2017).

Las declaraciones de sustentabilidad han sido adoptadas a muchos de los estatutos por las IES con la finalidad de consolidar proyectos de ahorro de energía y recursos, para materializar los objetivos de sustentabilidad deben aportar financiación a dichos proyectos como las siguientes estrategias (Shuqin et al., 2019):

1. Energía renovable esta la modernización energética de los edificios existentes, gestionar en facultades y oficinas iluminación de bajo consumo, instalación de paneles solares.
2. Uso del agua está renovar equipamiento con aparatos ahorradores de agua, instalación de sistemas de monitoreo en línea para evitar desperdicios, instalación de infraestructura para el manejo de agua de fuentes no tradicionales como la pluvial, gestionar plantas tratadoras de aguas residuales.
3. Uso de la tierra está el correcto uso del espacio subterráneo y la estratégica gestión para construir sin invasión o destrucción de muebles históricos, zonas naturales destinadas al cultivo o cualquier reserva natural, los sitios de construcción no deben ser espacios con amenazas de inundaciones o deslizamientos de tierra, debe vigilarse que los suelos no hayan estado contaminados. La estrategia que se privilegia es la reducción de superficie edificable.
4. Transporte verde está el uso de vehículos y transporte escolar de energía limpia para garantizar la seguridad de los viajes en bicicleta o una red de trasporte público como trolebuses lo que impactará en la necesidad de reducir estacionamientos y huella de carbón.
5. Arbolado y áreas verdes esta la plantación y conservación de plantas nativas y el manejo de programa de compostaje de residuos.
6. Material peligroso esta la gestión estricta en la recolección, almacenamiento y transmisión para procesos de químicos peligrosos o desperdicios orgánicos.
7. Residuos sólidos urbanos cada facultad u oficina debe evaluar el uso de materiales de construcción y papel reciclables, y establecer un programa de economía circular para reciclar, reducir y separar residuos de basura, composta, equipos electrónicos y mobiliario y equipamiento.

El análisis para la construcción de un sistema de evaluación arrojo para el Criterio III “Gestión y Desempeño Ambiental” los siguientes indicadores: III.1 Uso del agua, III.2 Energía renovable, III.3 Uso de la tierra, III.4 Arbolado y áreas verdes, III.5 Transporte verde, III.6 Material peligroso, y III.7 Residuos sólidos urbano.

4. Entorno y sociedad

Las diferentes actividades de las IES tienen un alcance social que se relacionan con la interacción con el exterior entre la comunidad local, la evaluación de alcance social se encuentra el apoyo del gobierno, la vinculación y establecimiento de proyectos de colaboración con empresas, IES e institutos de investigación, así como actividades en las cuales los estudiantes realizan prácticas comunitarias o servicio social comunitario definido en los diferentes programas sustentables (Alghamdi et al., 2017).

Las IES desarrollan actividades sociales que se relacionan con la vinculación con el sector productivo, con diversas instituciones de educación o investigación y con la sociedad mexicana, entre las actividades sociales que desarrollan las IES está la creación de empresas para motivar a estudiantes y personal a establecer empresas con enfoque sustentable, otra actividad es la colaboración para intercambiar conocimiento o financiación con empresas e instituciones, en cuanto a la difusión se puede llevar consultas y capacitaciones; finalmente el servicio social es una obligación para alumnos de pregrado por lo que

pueden seleccionar la participación en programas sustentables en comunidades rurales. (Shuqin et al., 2019).

Teniendo como objetivo las diferentes actividades sociales actuales, la evaluación del alcance social se relaciona principalmente con la capacitación y consulta en tecnología verde brindada a la comunidad, el apoyo político al gobierno, los proyectos de colaboración entre empresas, universidades e institutos de investigación, así como la participación de los estudiantes (Shuqin et al., 2019).

Los indicadores cubren la cantidad de actividades influyentes para apoyar la formulación de políticas para los gobiernos locales y nacionales, la participación en la compilación de estándares y directrices, la cantidad de premios provenientes de la colaboración efectiva entre industrias, universidades e institutos de investigación, y la proporción de las universidades que tienen estudiantes participan en actividades sustentables en comunidades o ciudades (Shuqin et al., 2019)

El análisis para la construcción de un sistema de evaluación arrojo para el Criterio IV "Entorno y sociedad" los siguientes indicadores: IV.1 Crear empresas, IV.2 Programa de servicio social, IV.3 Colaboración con empresas e instituciones, y IV.4 Consultas y capacitaciones.

En la tercera etapa se seleccionó Analytic Hierarchy Process (AHP) con la finalidad de proporciona un enfoque sistemático para medir intangibles y modelar problemas de decisión complejos con estructuras jerárquicas (Saaty, 1977).

La utilización del AHP es descomponer la problemática de medir el grado de sustentabilidad en diferentes niveles de jerarquía, donde el nivel superior representa el objetivo general que los decisores consideran prioritario, el segundo nivel corresponde a los criterios para la evaluación de dicho objetivo, los niveles inferiores son determinados por los indicadores que se estén evaluando.

En AHP, un problema complejo se descompone en decisiones que pueden ser comparadas las prioridades o el desempeño de los elementos que lo integran por nivel por pares, utilizando la escala fundamental de 9 puntos de Saaty que se muestra en la Tabla 4 (Saaty, 1977).

Tabla 4.
Intensidades de importancia relativa por comparación de pares

Intensidad	Equivalente lingüístico para comparación de criterios
1	De igual importancia
3	Moderada importancia
5	Fuerte importancia
7	Demostrada importancia
9	Extrema importancia
2, 4, 6, 8	Valores intermedios entre dos sentencias adyacentes

Fuente: Saaty (1977).

Las prioridades miden los intangibles en términos de su importancia relativa para los criterios con respecto a la meta, o preferencia relativa para los indicadores con respecto a un criterio dado, lo que hace que AHP sea autónomo a través de su capacidad para determinar los pesos de los criterios (Promentillaa et al., 2018).

El AHP es una teoría de medición para establecer las prioridades de la jerarquía y la consistencia de los datos de juicio proporcionados por el grupo de encuestados (Windt & Saaty, 1980).

Para calcular las prioridades, se establece la premisa de medir a partir de comparaciones, específicamente comparaciones por pares. Supongamos que tenemos n objetos $A_1, \dots, A_n$, y cuyo vector de pesos correspondiente es determinado por $w = (w_1, \dots . w_n)$

Formemos la matriz de comparaciones por pares de peso

$$A = \begin{matrix} \\ A_1 \\ \vdots \\ A_n \end{matrix} \begin{bmatrix} A_1 & \dots & A_n \\ w_1/w_1 & \dots & w_1/w_n \\ \vdots & & \vdots \\ w_n/w_1 & & w_n/w_n \end{bmatrix} \qquad (3)$$

Observamos que podemos recuperar la escala de pesos w_1, .. ., w_n multiplicando *A* o a la derecha por *w*, obteniendo *nw*, y luego resolviendo el problema de valores propios:

$$Aw = nw \qquad (4)$$

donde n es el valor propio más grande de A. En general, no conocemos las proporciones w_i/w_j, generalmente no son conocidas, pero se estiman de ellas a partir de datos, experimentos o opinión de expertos. Provocar un juicio e introducir automáticamente su recíproco en la posición de transposición, lo que conduciría a perturbaciones a A en el valor propio de A. Para obtener una estimación de los pesos *w*, el problema puede ser resuelto mediante

$$Aw = \lambda_{max} w \qquad (5)$$

Donde λ_{max} es el valor propio máximo de la matriz A y se pondera por la prioridad de la propiedad con respecto a la cual se hace la comparación. Es un proceso de extracción de vectores de los elementos en cualquier nivel de jerarquía. Por lo que es imposible una matriz perfectamente consistente, Por lo tanto, podemos adoptar un límite de consistencia aceptable por el siguiente índice de consistencia (CR):

$$CR = \frac{(\lambda_{max} - n)/(n-1)}{RI} \qquad (6)$$

Donde RI corresponde a r*andon inconsistency index* cuyo valor de determina en correspondencia al tamaño de la matriz. Si $CR \leq$ RI, según Tabla 5, la A tiene un límite consistente aceptable, de lo contrario se deberá revisar las comparaciones por pares.

Tabla 5.
Indice Aleatorio

N	1	2	3	4	5	6	7	8	9	10
RI	0.0	0.0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

La práctica en el uso del método AHP hace que las personas puedan comprender las influencias, han desarrollado capacidades para capturar la importancia haciendo juicios de comparación por pares en una matriz que es el principal vector o en el modelo jerárquico compuesto por varias matrices de comparación por pares.

El procedimiento tiene la cuantificación de sus preferencias como la relación con la realidad y la apreciación de los expertos, existe el debate entre posiciones que pueden razonar y analizar de manera juiciosa o actuar de manera intuitiva o emocional, así como su cuantificación mediante una escala. La toma de decisiones racionales es un talento en el que implementamos las ideas en el mundo real, existirán riesgos y resistencia en cualquiera de los tipos de decisiones que implementemos -normativa o descriptiva- (Whitaker, 2007).

Una buena elección depende que tan bien conocemos las alternativas sustentables en comparación entre ellas y la manera de clasificarlas para ingresarlas al modelo o colocarlas fuera de la colección, el inconveniente es un conocimiento limitado que no permita la estabilidad de las elecciones, dado que priorizamos las ideas en conjuntos de comparaciones pares, se debe vigilar que los criterios intangibles sean mediciones reales que puedan ser usadas con precisión. La estabilidad del resultado es mediante el análisis de sensibilidad para conocer las perturbaciones en los juicios.

Las consideraciones éticas sobre el trabajo es cuando alguien usa el proceso sin conocimientos y compresión adecuados podría obtener respuestas que puedan validarse contra la observación (Whitaker, 2007). La toma de decisiones es necesario el conocimiento informado en el tema de sustentabilidad, de lo contrario, la estructura del modelo puede no tener éxito y la comparación de los elementos pueden carecer de precisión. La toma de decisiones grupales tienden a mejorar los resultados, por la razón de compartir un amplio conocimiento y provocar sinergías en los debates que conducen a una retroalimentación en el modelo y los juicios que conducen a decisiones mejoradas.

Resultados y discusión

En el estudio se evaluaron los criterios e indicadores de sustentabilidad utilizando AHP de una IES mexicana, la cual su participación está conformada en tres campus que definen la toma de decisión sobre el desempeño de la sustentabilidad. Esta evaluación utilizó el método de AHP para determinar las ponderaciones de los principales niveles de sustentabilidad de sus campus. La evaluación a los grupos de expertos nos permite obtener las ponderaciones de los criterios e indicadores, los resultados fueron transferidos a una hoja de cálculo con la finalidad de describir la importancia relativa de los principales factores de sustentabilidad para cada una de los campus representadas por campus Norte DF C1, Centro DF C2 y Pachuca C3.

Esta jerarquía se basa en el grado de desarrollo de sustentabilidad expresado en cuatro criterios: gestión y desempeño ambiental (GDA), entorno y sociedad (ES), educación, investigación y desempeño (EID) y estructura y gestión (EG). Cada uno de los criterios tienen a su vez indicadores que son eventos que pueden presentarse. Dada la naturaleza de la información sobre los planes de la institución para la asignación de sus recursos para el desarrollo de sustentabilidad, las opciones reales son mencionadas por letras y números que no corresponden en ningún orden a los elementos enumerados anteriormente.

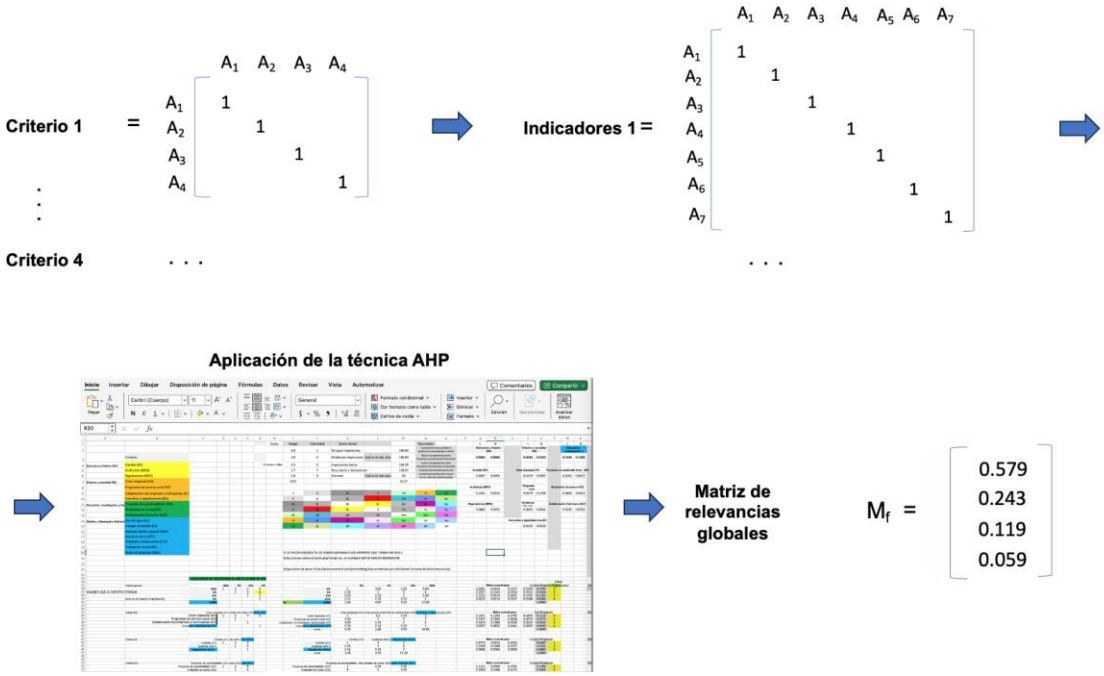

Figura 2. Esquema general para la aplicación de la técnica AHP de acuerdo a los cuatro criterios y sus 7,4,3,3 indicadores respectivamente. Donde se resalta la matriz de relevancias globales M_f

Los resultados a través de decisiones expertas, define cinco matrices por pares para el objetivo y los criterios. La matriz de evaluación AHP para los principales criterios de sustentabilidad se describe en la Tabla 6, que determinó los pesos de los factores principales.

Tabla 6.
Matriz de evaluación de AHP con respecto a los principales criterios de sustentabilidad

Matriz normalizada de factores de sustentabilidad	EG	ES	EID	GDA	Vector
EG	0.6081	0.6429	0.5357	0.5294	0.5790
ES	0.2027	0.2143	0.3214	0.2353	0.2434
EID	0.1216	0.0714	0.1071	0.1765	0.1192
GDA	0.0676	0.0714	0.0357	0.0588	0.0584
RC = 0.07					

Posteriormente se describen cuatro matrices de evaluación AHP para los cuatro criterios en los que se evalúo la sustentabilidad de los campus de la IES (Tablas 7, 8, 9 y 10)

Tabla 7.
Matriz de evaluación de AHP respecto al criterio Entorno y Sociedad (ES)

Matriz normalizada para ES	V1	V2	V3	D1	Vector
V1	0.1071	0.1193	0.0735	0.1875	0.1219
V2	0.5357	0.5966	0.6618	0.4375	0.5579
V3	0.3214	0.1989	0.2206	0.3125	0.2633
D1	0.0357	0.0852	0.0441	0.0625	0.0569
RC = 0.07					

Tabla 8.
Matriz de evaluación de AHP respecto al criterio Estructura y Gestión (EG)

Matriz normalizada para EG	O1	MG1	MG2	Vector
O1	0.6774	0.6923	0.6364	0.6687
MG1	0.2258	0.2308	0.2727	0.2431
MG2	0.0968	0.0769	0.0909	0.0882
RC = 0.01				

Tabla 9.
Matriz de evaluación de AHP respecto al criterio Educación, Investigación y Desarrollo (EID)

Matriz normalizada para EID	ID1	ID2	AC1	Vector
ID1	0.1111	0.0769	0.1304	0.1062
ID2	0.3333	0.2308	0.2174	0.2605
AC1	0.5556	0.6923	0.6522	0.6333
RC = 0.05				

Tabla 10.
Matriz de evaluación de AHP respecto al criterio Gestión y Desempeño Ambiental (GDA)

Matriz normalizada para GDA	A1	E1	MD2	OT1	OT2	M1	MD1	Vector
A1	0.3693	0.3348	0.5063	0.4198	0.3251	0.2967	0.2195	0.3531
E1	0.3693	0.3348	0.3038	0.2998	0.2322	0.2308	0.2195	0.2843
MD2	0.0739	0.1116	0.1013	0.1799	0.2322	0.1648	0.1707	0.1478
OT1	0.0528	0.0670	0.0338	0.0600	0.1393	0.1648	0.1707	0.0983
OT2	0.0528	0.0670	0.0203	0.0200	0.0464	0.0989	0.1220	0.0610
M1	0.0410	0.0478	0.0203	0.0120	0.0155	0.0330	0.0732	0.0347
MD1	0.0410	0.0372	0.0145	0.0086	0.0093	0.0110	0.0244	0.0208
RC = 0.01								

Se determinó la correspondencia de cada matriz consistentemente aceptable.

Se puede considerar que diversas IES gestionan la sustentabilidad sobre marcos comunes, lo que se ve reflejado en la literatura considerada, donde se puede destacar que la evaluación de la sustentabilidad de las IES se agrupa en denominadores comunes identificados con estas cinco áreas. Las IES utilizan un marco que les permitan mejorar el rendimiento de la sustentabilidad y que incluyan aspectos propios de la IES. La Universidad de Hokkaido evalúa cuatro dimensiones 1) gestión, 2) educación e investigación, 3) comunidad local y 4) ambiente (Hokkaido University, 2023), la Universidad de Montreal evalúa su sustentabilidad en cuatro dimensiones 1) planificación y gestión, 2) enseñanza e investigación, 3) operaciones, y 4) compromiso social (Montreal University, 2020). Cada IES enfrenta diferentes desafíos y cada IES, considera aspectos endógenos y exógenos, lo cual permite adaptar su propia herramienta a sus particulares necesidades basada en el marco propuesto (Figura 2).

Universidad mexicana	Universidad de Hokkaido
I. Estructura y Gestión (EG)	**I. Gestión**
I.1 Comités (O1)	I.1 Política y plan general
I.2 Auditorias (MG1)	I.2 Organización para considerar la sostenibilidad
I.3 Regulaciones (MG2)	I.3 Gestión de recursos financieros
	I.4 Gestión de activos
	I.5 Gestión de instalaciones
	I.6 Red para mejorar la sostenibilidad
	I.7 Formación del personal
	I.8 Adquisiciones y contratos
II. Educación, Investigación y Desarrollo (EID)	**II Educación e Investigación**
II.1 Proyectos de sustentabilidad (ID1)	II.1 Educación
II.2 Graduados de cursos (ID2)	II.2 Investigación
II.3 Consultas y capacitaciones (AC1)	II.3 Estudiantes
III. Gestión y Desempeño Ambiental (GDA)	**III. Ambiente**
III. 1 Uso del agua (A1)	III.1 Ecosistema
III.2 Energía renovable (E1)	III.2 Tierra
III.3 Uso de la tierra (OT1)	III.3 Espacio público
III.4 Arbolado y áreas verdes (OT2)	III.4 Paisaje
III.5 Transporte Verde (M1)	III.5 Residuos
III.6 Material peligroso (MD1)	III.6 Energía y recursos
III.7 Residuos sólidos urbanos (MD2)	III.7 Equipo básico
	III.8 Instalaciones
	III.9 Transporte
	III.10 Uso de bienes históricos en el campus
IV. Entorno y sociedad (ES)	**IV. Comunidad local**
IV.1 Crear empresas (V1)	IV. Colaboración industria, academia y gobierno.
IV.2 Programas de servicio social (V2)	IV. Servicio comunitario
IV.3 Colaboración empresas e inst. (V3)	IV. Diseminacion de información
IV. 4Consultas y capacitaciones (D1)	IV. Prevención de desastres
	IV. Papel de la universidad después de un desastre

Figura 3. Criterios e indicadores utilizados por la Universidad de Hokkaido y la IES mexicana.

Como se ve en la Tabla 11, el criterio gestión y desempeño ambiental (GDA) es el factor principal más importante y el criterio menos importante es estructura y gestión (EG). El comportamiento del sistema de evaluación de la sustentabilidad es el siguiente:

- El primer criterio más importante es gestión y desempeño ambiental (GDA) y su indicador más importante es la alternativa uso del agua (A1) y material peligroso (MD1) es la alternativa menos importante, se considera que el arbolado y áreas verdes (OT2) es un indicador con valor intermedio.
- El segundo criterio de importancia es entorno y sociedad (ES), las alternativas más importantes es el indicador programas de servicio social (V2), de manera intermedia se considera colaboración con empresas e instituciones (V3) y creación de empresas (V1), finalmente se considera la menos importante consultas y capacitaciones (D1).
- El tercer criterio de importancia es educación, investigación y desarrollo (EID), dentro de las alternativas, el indicador oferta educativa (AC1) es el más importante, y el menos importante es

proyectos de sustentabilidad (ID1), los graduados de cursos (ID2) se considera como un indicador de alternativa intermedia.

- Por otro lado, para el último criterio denominado estructura y gestión (EG) se encuentran a los comités (O1) como indicador de mayor importancia, posteriormente auditorías (MG1) en el siguiente nivel de importancia y finalmente regulaciones (MG2).

Tabla 11.
Ponderación prioritaria de criterios e indicadores de sustentabilidad con respecto a los campus. En la tabla se presenta el criterio por prioridad indicado entre paréntesis en la tercera columna, de la misma manera también los indicadores en la quinta columna.

Criterios de sustentabilidad	Indicadores de sustentabilidad	Prioridad por criterio	Prioridad por indicador dentro de su propio criterio	Prioridad general del indicador
Gestión y Desempeño Ambiental (GDA)	Uso del agua (A1)	0.5790 (1)	0.3531 (1)	0.2044 (1)
	Energía renovable (E1)		0.2843 (2)	0.1646 (2)
	Residuos sólidos urbanos (MD2)		0.1478 (3)	0.0856 (4)
	Uso de la tierra (OT1)		0.0983 (4)	0.0569 (7)
	Arbolado y áreas verdes (OT2)		0.0610 (5)	0.0353 (9)
	Transporte Verde (M1)		0.0347 (6)	0.0201 (12)
	Material peligroso (MD1)		0.0208 (7)	0.0122 (16)
Entorno y sociedad (ES)	Programas de servicio social (V2)	0.2434 (2)	0.5579 (1)	0.1358 (3)
	Colaboración con empresas e inst. (V3)		0.2633 (2)	0.0641 (6)
	Crear empresas (V1)		0.1219 (3)	0.0297 (10)
	Consultas y capacitaciones (D1)		0.0569 (4)	0.0138 (13)
Educación, Investigación y Desarrollo (EID)	Oferta Educativa (AC1)	0.1192 (3)	0.6333 (1)	0.0755 (5)
	Graduados de cursos (ID2)		0.2605 (2)	0.0310 (11)
	Proyectos de sustentabilidad (ID1)		0.1062 (3)	0.0127 (15)
Estructura y Gestión (EG)	Comités (O1)	0.0584 (4)	0.6687 (1)	0.0390 (8)
	Auditorias (MG1)		0.2431 (2)	0.0142 (14)
	Regulaciones (MG2)		0.0882 (3)	0.0051 (17)

En la Tabla 12, se describe el comportamiento de cada criterio respecto del mayor y menor desempeño de los indicadores o alternativas en cada uno de los campus:

- Para el factor denominado gestión y desempeño ambiental (GDA) se identifica como de mayor importancia el uso de agua (A1) para el campus C1 y la alternativa de menor importancia es el indicador de transporte verde (M1) para el campus C2.
- Para el criterio de entorno y sociedad (ES), encontramos que el desempeño de la sustentabilidad fue medido como de mayor importancia el programa de servicio social (V2) para el campus C1, y la alternativa de menor importancia es consultas y capacitaciones (D1) en el campus C3.
- El criterio de educación, investigación y desarrollo (EID) presenta la mayor importancia en la oferta educativa (AC1) del campus C1 y una menor importancia es la alternativa de proyectos de sustentabilidad (ID1) para el campus C3.
- La estructura y gestión (EG), el mejor desempeño corresponde al indicador de los comités (O1) en el C1 y el indicador de importancia menor fue en las regulaciones (MG2) en el campus C3.

Tabla 12.
Pesos para criterios de sustentabilidad con respecto a su importancia. En la tabla se presenta por prioridad los criterios pertenecientes a cada campus indicado entre paréntesis en la quinta columna.

Criterio	Indicador	Campus	Ponderación por indicador	Ponderación por criterio
Gestión y Desempeño Ambiental (GDA)	Uso del agua (A1)	C1	0.6687	0.2361 (1)
	Transporte Verde (M1)	C2	0.0598	0.0021 (21)
Entorno y sociedad (ES)	Programas de servicio social (V2)	C1	0.6739	0.3759 (1)
	Consultas y capacitaciones (D1)	C3	0.1062	0.0060 (12)
Educación, Investigación y Desarrollo (EID)	Oferta educativa (AC1)	C1	0.4286	0.2714 (1)
	Proyectos de sustentabilidad (ID1)	C3	0.1062	0.0113 (9)
Estructura y Gestión (EG)	Comités (O1)	C1	0.6333	0.4235 (1)
	Regulaciones (MG2)	C3	0.0669	0.0059 (9)

En la Tabla 13, se enuncian las ponderaciones globales de la sustentabilidad con respecto a su importancia, identificando los puntos favorables, así como los puntos críticos que afectan de manera global la sustentabilidad de la institución. Entre los resultados favorables del sistema encontramos: 1) el criterio de Gestión y Desempeño Ambiental (GDA), en la alternativa del uso del agua en el campus C1, 2) criterio de Gestión y Desempeño Ambiental (GDA), en la alternativa de Energía renovable (E1) para el C3; y 3) en el criterio Entorno y sociedad (ES), en la alternativa Programas de servicio social (V2) en el campus C1.

Tabla 13.
Pesos globales de sustentabilidad con respecto a su importancia. En la tabla se presenta la prioridad general del sistema indicado entre paréntesis en la sexta columna.

Criterio	Indicador	Campus	Ponderación por indicador	Ponderación por criterio	Ponderación general
Gestión y Desempeño Ambiental (GDA)	Uso del agua (A1)	C1	0.6687	0.2361	0.1367 (1)
Gestión y Desempeño Ambiental (GDA)	Energía renovable (E1)	C3	0.6333	0.1801	0.1043 (2)
Entorno y sociedad (ES)	Programas de servicio social (V2)	C1	0.6739	0.3759	0.0915 (3)
Gestión y Desempeño Ambiental (GDA)	Residuos sólidos urbanos (MD2)	C3	0.6687	0.0988	0.0572 (4)
Gestión y Desempeño Ambiental (GDA)	Uso del agua (A1)	C2	0.2431	0.0858	0.0497 (5)
Gestión y Desempeño Ambiental (GDA)	Energía renovable (E1)	C1	0.2605	0.0741	0.0429 (6)
Gestión y Desempeño Ambiental (GDA)	Uso de la tierra (OT1)	C3	0.7482	0.0736	0.0426 (7)
Entorno y sociedad (ES)	Colaboración con emp. e inst. (V3)	C1	0.6434	0.1694	0.0412 (8)
Entorno y sociedad (ES)	Programas de servicio social (V2)	C3	0.2693	0.1502	0.0366 (9)
Educación, Inves. y Desarrollo (EID)	Ambientación Curricular (AC1)	C1	0.4286	0.2714	0.0323 (10)
Educación, Inves. y Desarrollo (EID)	Ambientación Curricular (AC1)	C2	0.4286	0.2714	0.0323 (11)
Estructura y Gestión (EG)	Comités (O1)	C1	0.6333	0.4235	0.0247 (12)
Gestión y Desempeño Ambiental (GDA)	Arbolado y áreas verdes (OT2)	C3	0.6687	0.0408	0.0236 (13)
Gestión y Desempeño Ambiental (GDA)	Residuos sólidos urbanos (MD2)	C1	0.2431	0.0359	0.0208 (14)
Educación, Inves. y Desarrollo (EID)	Graduados de cursos (ID2)	C2	0.6434	0.1676	0.0200 (15)
Entorno y sociedad (ES)	Crear empresas (V1)	C1	0.6687	0.0815	0.0198 (16)
Entorno y sociedad (ES)	Colaboración con emp. e inst. (V3)	C3	0.2828	0.0745	0.0181 (17)
Gestión y Desempeño Ambiental (GDA)	Uso del agua (A1)	C3	0.0882	0.0311	0.0180 (18)

Gestión y Desempeño Ambiental (GDA)	Energía renovable (E1)	C2	0.1062	0.0302	0.0175 (19)
Gestión y Desempeño Ambiental (GDA)	Transporte Verde (M1)	C3	0.6583	0.0228	0.0132 (20)
Educación, Inves. y Desarrollo (EID)	Ambientación Curricular (AC1)	C3	0.1429	0.0905	0.0108 (21)
Gestión y Desempeño Ambiental (GDA)	Uso de la tierra (OT1)	C1	0.1804	0.0177	0.0103 (22)
Estructura y Gestión (EG)	Comités (O1)	C2	0.2605	0.1742	0.0102 (23)
Estructura y Gestión (EG)	Auditorias (MG1)	C1	0.6333	0.1540	0.0090 (24)
Educación, Inves. y Desarrollo (EID)	Graduados de cursos (ID2)	C1	0.2828	0.0737	0.0088 (25)
Entorno y sociedad (ES)	Consultas y capacitaciones (D1)	C1	0.6333	0.0360	0.0088 (26)
Gestión y Desempeño Ambiental (GDA)	Arbolado y áreas verdes (OT2)	C1	0.2431	0.0148	0.0086 (27)
Educación, Inves. y Desarrollo (EID)	Proyectos de sustentabilidad (ID1)	C1	0.6333	0.0672	0.0080 (28)
Entorno y sociedad (ES)	Programas de servicio social (V2)	C2	0.0569	0.0317	0.0077 (29)
Gestión y Desempeño Ambiental (GDA)	Material peligroso (MD1)	C2	0.6333	0.0132	0.0076 (30)
Gestión y Desempeño Ambiental (GDA)	Residuos sólidos urbanos (MD2)	C2	0.0882	0.0130	0.0075 (31)
Entorno y sociedad (ES)	Crear empresas (V1)	C2	0.2431	0.0296	0.0072 (32)
Gestión y Desempeño Ambiental (GDA)	Transporte Verde (M1)	C1	0.2819	0.0098	0.0057 (33)
Entorno y sociedad (ES)	Colaboración con emp. e inst. (V3)	C2	0.0738	0.0194	0.0047 (34)
Estructura y Gestión (EG)	Comités (O1)	C3	0.1062	0.0710	0.0041 (35)
Gestión y Desempeño Ambiental (GDA)	Uso de la tierra (OT1)	C2	0.0714	0.0070	0.0041 (36)
Estructura y Gestión (EG)	Auditorias (MG1)	C3	0.2605	0.0633	0.0037 (37)
Estructura y Gestión (EG)	Regulaciones (MG2)	C1	0.7132	0.0629	0.0037 (38)
Entorno y sociedad (ES)	Consultas y capacitaciones (D1)	C2	0.2605	0.0148	0.0036 (39)
Educación, Inves. y Desarrollo (EID)	Proyectos de sustentabilidad (ID1)	C2	0.2605	0.0277	0.0033 (40)
Gestión y Desempeño Ambiental (GDA)	Material peligroso (MD1)	C1	0.2605	0.0054	0.0031 (41)
Gestión y Desempeño Ambiental (GDA)	Arbolado y áreas verdes (OT2)	C2	0.0882	0.0054	0.0031 (42)
Entorno y sociedad (ES)	Crear empresas (V1)	C3	0.0882	0.0107	0.0026 (43)
Educación, Inves. y Desarrollo (EID)	Graduados de cursos (ID2)	C3	0.0738	0.0192	0.0023 (44)
Estructura y Gestión (EG)	Auditorias (MG1)	C2	0.1062	0.0258	0.0015 (45)
Entorno y sociedad (ES)	Consultas y capacitaciones (D1)	C3	0.1062	0.0060	0.0015 (46)
Educación, Inves. y Desarrollo (EID)	Proyectos de sustentabilidad (ID1)	C3	0.1062	0.0113	0.0013 (47)
Gestión y Desempeño Ambiental (GDA)	Material peligroso (MD1)	C3	0.1062	0.0022	0.0013 (48)
Gestión y Desempeño Ambiental (GDA)	Transporte verde (M1)	C2	0.0598	0.0021	0.0012 (49)
Estructura y Gestión (EG)	Regulaciones (MG2)	C2	0.2200	0.0194	0.0011 (50)
Estructura y Gestión (EG)	Regulaciones (MG2)	C3	0.0669	0.0059	0.0003 (51)

Se presenta las capacidades de evaluación que debe presentar la IES para crear las condiciones marco sustentables en el ámbito legal, formativo y normativo. La evaluación de la sustentabilidad permitió medir las acciones que identifican como importantes a cada campus, el **DCE va más allá de la evaluación de indicadores,** se focaliza en la comprensibilidad. En la Tabla 14 se identifican las acciones que deberá

realizar el personal con las habilidades evaluativas específicas, se deberá preparar a futuro la planeación para la asignación de recursos y poder realizar las evaluaciones particulares.

Tabla 14.
Implicaciones de la evaluación de la sustentabilidad y medidas del DCE

Indicador	Implicaciones de la evaluación de la sustentabilidad	Necesidades sobre las medidas de DCE	Ranking de las 15 prácticas críticas en los campus
Regulaciones (MG2)	Aplicación de la Ley y Reglamentos Federales para la prevención y gestión integral de los residuos LEGAL	• Crear bases legales para la elaboración obligatoria de evaluaciones de sustentabilidad. • Utilización de evaluación de estándares, evaluación de prácticas, autoevaluación y evaluaciones internacionales. • Desarrollar indicadores comunes y publicar los catálogos. • Fortalecer los procesos de recolección y sistematización de la información.	• C3 (51) • C2 (50) • C1 (38)
Auditorías (MG1)	Personal profesional que ubique el contenido, aplicación, análisis de datos, interpretación de datos y elaboración de reportes que el gobierno mexicano requiere. NORMATIVO	• Establecer una estructura del personal que evalúa, (puestos de trabajo, agencias, unidades, departamento) para los requerimientos de auditorías.	• C2 (45) • C3 (37)
Consultas y capacitaciones (D1)	Fortalecer los procesos de sustentabilidad a través de redes y de asociaciones profesionales para brindar servicio a las partes interesadas. FORMATIVO	• Crear asociaciones profesionales. • Crear y potenciar redes de asociaciones profesionales. • Ampliar el número y la calidad de publicaciones por parte de evaluadores profesionales. • Crear redes electrónicas, listas de discusión, directorios, comunidades en Internet.	• C3 (46) • C2 (39)
Material peligroso (MD1)	Regulación y obligatoriedad de normas institucionales para la gestión de adquisiciones ecológicas y manejo de residuos peligrosos NORMATIVO	• Crear guías para el seguimiento de norma, referente a contenido mínimo, métodos y herramientas de evaluación a utilizar. • Crear y promover estándares y una ética profesional.	• C3 (48) • C1 (41)
Graduados de cursos (ID2)	Educación y Formación Ambiental para la Sustentabilidad FORMATIVO	• Promocionar la evaluación como un vehículo de aprendizaje de la sustentabilidad. • Desarrollar diagnósticos institucionales para poder adecuar la oferta de formación académica en unidades de aprendizaje y recomendaciones a los planes de estudios. • Desarrollar diagnósticos con la colaboración de empresas para actualizar las descripciones y perfiles de puestos de trabajos para las fichas de egreso.	• C3 (44)
Arbolado y áreas verdes (OT2)	Gestiona el patrimonio natural bajo su resguardo NORMATIVO	• Impulsar lineamientos de planeación territorial de la IES y conservación de sus espacios naturales, a través de Áreas Institucionales de Conservación Ecológica. • Realizar diagnósticos e inventarios de programas de manejo que aseguren la conservación de áreas verdes. • Elaborar y difundir los planes de acción consensuado sobre arbolado y áreas verdes antes de iniciar otras actuaciones.	• C2 (42)

Proyectos de sustentabilidad (ID1)	Desarrollar proyectos de investigación en temas de sustentabilidad FORMATIVO	• Incentivar la investigación sobre nuevos métodos, nuevas herramientas. • Apoyar el análisis de los propios sistemas de evaluación y la investigación sobre su mejora. • Crear y promover centros de investigación sobre evaluación de la sustentabilidad. • Crear un centro de documentación sobre evaluación de la sustentabilidad y sus resultados históricos.	• C3 (47) • C2 (40)
Transporte verde (M1)	Desarrollar modos de transporte con mínimo impacto ambiental NORMATIVO	• Generar diagnósticos sobre ecomovilidad. • Evaluar la implementación de una logística verde para personas e insumos que requiere la IES.	• C2 (49)
Crear empresas (V1)	Establecer empresas con enfoque sustentable LEGAL	• Incentivar el desarrollo de nuevas tecnologías y procesos más eficientes, para reducir emisiones y mejorar la eficiencia energética. • Crear de nuevos productos y servicios que responden a las demandas. • Colaboración para intercambiar conocimiento o financiación entre empresa e institución.	• C3 (43)

Se considera el uso de métodos de toma de decisiones de criterios múltiple, como el AHP, para modelar y resolver una simplificación de problemas reales. El método AHP presenta limitaciones para modelar proyectos a evaluar con un gran número de alternativas y criterios; cuando no existen criterios independientes, relaciones entre alternativas que incluyen dependencia, inclusividad, exclusividad y obligación de considerar dos alternativas; también en la selección obligatoria de un proyecto en la clasificación final. El presente trabajo asume la existencia de inconvenientes en el uso de características jerárquicas, las dificultades en la gestión de la evaluación de la sustentabilidad puede mejorarse mediante el uso de formas más complejas utilizando estructuras funcionales y de matriz. Existe la necesidad de tener un análisis de sensibilidad basado en motivos sólidos, no en preferencias, para no alejarse de la realidad, lo que también de alguna forma define las limitaciones del método AHP.

Finalmente, la IES debe implementar la creación de una estructura orgánica de gestión de la sustentabilidad para que se pueda adoptar el sistema de evaluación de la sustentabilidad como herramienta de planeación, con orientación de las medidas de austeridad y uso eficiente de recursos en los rubros de agua, energía, patrimonio natural y arbolado, áreas protegidas, edificaciones sustentables, residuos y emisiones, compras verdes, movimiento y transporte. En la actualidad las IES encuentran barreras como recursos finitos, regulaciones e influencia y control de las partes interesadas, por lo que en futuros estudios sobre la construcción de sistemas de evaluación de la sustentabilidad deberían crearse las condiciones marco considerando el DCE y con el apoyo de la tecnología para desarrollar métodos que sean capaces de representar la realidad con precisión.

Conclusiones

La creación del sistema de evaluación de la sustentabilidad requiere la construcción de la relación entre los evaluadores y los profesionales del tema de sustentabilidad que conducen a la toma de decisiones y el significado, en el presente estudio se reforzaron canales para poder negociar conjuntamente, permitiendo avanzar en la evaluación y en la iniciativa del DCE en condiciones limitadas de recursos y capacidad de evaluación.

El uso de Delphi y AHP demostró que son herramientas eficientes para la toma de decisión, priorizando los criterios e indicadores más representativos para el desarrollo de campus verdes en México. La evaluación participativa logró el objetivo de priorizar los rubros de desempeño para una institución sustentable. Los métodos Delphi y AHP han podido verificar las percepciones de 24 expertos en criterios cuantificables. El método Delphi promovió de manera anónima que los encuestados compartieran sus opiniones de manera libre. El método AHP transformó las opiniones en priorización de criterios e indicadores sobre

sustentabilidad. La participación de los 24 expertos se conservó en las dos rondas, así como la recolección de información que podría ser de interés para análisis futuros.

Cabe señalar que, dentro de los inconvenientes, el panel de expertos utilizo consideraciones para modelar el sistema dado el amplio conjunto de indicadores, así como contener la mayor información del conjunto inicial de indicadores. Es recomendable el uso de formas más complejas utilizando estructuras funcionales y de matriz que representen con mayor precisión la realidad.

Los resultados sobre los criterios de sustentabilidad demuestran el interés de las IES sobre su responsabilidad, propósito y alcance con respecto a la sustentabilidad, lo que sugiere criterios que deben considerarse para que la evaluación de la sustentabilidad puede ser utilizada como aprendizaje institucional y de manera paralela para el desarrollo de la capacidad. Como resultado, la gestión y desempeño ambiental (GDA) un aspecto esencial en el estudio. El enfoque se centra en la prioridad de la IES sobre la aplicación de las reformas en materia de energía y recursos naturales y la aplicación de políticas sobre sustentabilidad. Sin embargo, son críticas las posiciones de entorno y sociedad (ES), educación, investigación y desarrollo (EID) y estructura y gestión (EG). Los resultados globales arrojan que los campus tienen diferentes estadios de sustentabilidad, con estos resultados se establecen estrategias DCE que permiten promover la evaluación de la sustentabilidad como un componente de la gestión institucional y la adopción de la evaluación en una cultura sustentable de la IES.

La aplicación de DCE ayudó que se integren de manera sistémica acciones sustentables en escenarios que requieran los campus o la IES, evaluar de manera intencional con orientación a procesos y prácticas sustentables. Para asegurar la sustentabilidad en la institución, se deben determinar las estrategias de DCE de manera sistémica, considerando las prioridades de las regulaciones y los criterios e indicadores que sean críticos en los campus. Existe un campo para desarrollar futuras investigaciones del DCE en IES sustentables, este estudio evaluativo establece un modelo cuantitativo ejemplar para campus sustentable mexicano.

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