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Exploitation of intellectual property systems for the manipulation of academic reputations

Reese A. K. Richardson[1*], Nick H. Wise[2,3], Spencer S. Hong[1], Michael J. Draper[4] and Sarah Fackrell[5]

*Correspondence: reeserichardson2019@u.northwestern.edu

[1] Department of Engineering Sciences and Applied Mathematics, Northwestern University, Evanston, USA
[2] Clare College, University of Cambridge, Cambridge, UK
[3] Taylor & Francis, Oxfordshire, UK
[4] Hillary Rodham Clinton School of Law, Swansea University, Swansea, UK
[5] Chicago-Kent College of Law, Illinois Institute of Technology, Chicago, USA

Abstract

Patents are sought by academics and their institutions to protect their inventions. Academics also seek patents to enhance their individual profile and status for the purpose of job and promotion opportunities. Some institutions recognize the awarding of a patent to an individual academic as equivalent to or sometimes greater than publication in an international peer-reviewed journal. This article addresses the concerning development of patent inventorship credit (or credit that might be viewed as inventorship credit) being offered for sale by established education fraud companies alongside offers for authorship on academic papers and thesis writing. This article focuses on design registration in the United Kingdom (UK) but the issues identified are globally applicable. We characterize in detail the footprint of eight firms that are likely involved in the sale of thousands of UK registered designs to Indian academics for the purpose of academic reputation manipulation. Unlike patents, design registration applications are not examined for novelty or individual character (i.e. for whether the designs are actually new or innovative). Due to this limited examination process, these registrations generally issue quite quickly. We argue that exploitation of intellectual property systems should be considered one facet of the global enterprise of education fraud, alongside essay mills, diploma mills and research paper mills.

Keywords: Intellectual property, Education fraud, Designs, Patents, Credential mills

Introduction

Education fraud is a global business enterprise. The Council of Europe Recommendation on Countering Education Fraud, passed in July 2022, widely defines education fraud as an action intended to deceive and obtain an unfair advantage in an educational context (Recommendation cm/rec(2022)18 of the committee of ministers to member states on countering education fraud (adopted by the committee of ministers on 13 july 2022 at the 1440th meeting of the ministers' deputies) n.d). The Recommendation goes onto state that it includes the activities of diploma mills, accreditation mills, visa mills, essay mills and essay banks, illegal impersonation or irregular use of authentic documents, plagiarism, the production or use of forged, plagiarised or counterfeit documents and the offer of unrecognised or unaccredited qualifications with the intention of deceiving another. Businesses that facilitate education fraud are

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believed to offer a variety of these services (Eaton and Carmichael 2023; Ezell 2023). The Recommendation does not expressly identify education fraud involving a form of intellectual property (IP). Patents protect technical or scientific inventions, giving the inventor an enforceable legal right to prevent others from practicing the claimed invention.

Patents are sought by academics and their institutions to protect their inventions. Patents are also sought by academics to enhance their individual profile and status for the purpose of institutional promotion and job opportunities. There is a growing impetus to explicitly incentivize patent-seeking in university tenure and promotion policies (Stevens et al. 2011; Sanberg et al. 2014; Carter et al. 2021; Bouwma-Gearhart et al. 2021). Hall et al. estimate that 23% of universities worldwide explicitly cited patents and other aspects of commercialization in their university-wide promotion criteria (Hall et al. 2024). Some countries, including India (Ugc regulations on minimum qualification for appointment of teachers and other academic staff in universities and colleges and measures for the maintenance of standards in higher education 2018) and Pakistan (Revised statutes for promotion of professor (BPS-21) to meritorious professor (BPS-22) n.d), formalize these criteria within points-based promotion systems. The University Grants Commission (UGC), a department of the Ministry of Education (MOE) of the government of India, specifies a points-based scheme for assessing faculty on their academic achievements that includes patents (UGC regulations on minimum qualification for appointment of teachers and other academic staff in universities and colleges and measures for the maintenance of standards in higher education 2018). Under this scheme, publishing a research paper in a peer-reviewed or UGC-listed (University Grants Commission consortium for academic and research ethics (UGC-CARE) list n.d) journal contributes 8 points to an academic's research score (with additional points awarded for publications in high-impact journals), whereas obtaining an "international" patent (presumably meaning a patent outside of India) earns 10 points and an Indian patent 7 points. The UGC recommends that to be promoted from associate professor to full professor in the humanities and sciences, academics have a minimum research score of 120. The number of patents granted to an institution's employees also counts towards its placement in a variety of institutional ranking frameworks (Vernon et al. 2018), including in the MOE National Institutional Ranking Framework (NIRF) (India rankings 2023 National Institutional Ranking Framework methodology for ranking of academic institutions in india (ranking metrics for overall) n.d).

The MOE frameworks do not specify what kind of patents qualify. However, some countries offer more than one type of patent. For instance, the United States (US) issues both utility patents, which protect scientific or technical innovations, as well as design patents, which protect visual innovations. Other jurisdictions, including the United Kingdom (UK), do not issue design patents but do offer other forms of IP including "registered designs". Like a US design patent, a UK registered design protects the way a products looks, not how it functions. Unlike a US utility patent or a US design patent, UK registered designs are not examined for novelty prior to issuance. Instead, they are subject only to a limited ex ante examination, mostly for formalities (Burstein 2012; Howe et al. 2010).

Here, we report on our discovery of businesses selling authorship slots on registered design rights in the UK (advertised as "UK design patents") to academics in India for the explicit purpose of accruing points in the UGC scoring scheme and the NIRF ranking.

Methods

All design data was obtained from DesignView (DesignView n.d) using the service's "Export to Excel" function, 150 entries at a time. .xlsx workbooks were extracted as ZIP archives to obtain thumbnail images of each patent. We used *difPy* v4.0.1 to identify duplicate images.

To expand our search for firms possibly also in the business of filing UK designs for academic reputation manipulation, we downloaded all 1,426 registered designs filed under Locarno class 24.01, the most common class for designs filed by Firm A and Firm E, since January 1, 2023. We then identified the 15 firms that had filed the most registered designs under this class and downloaded every registered design each firm had filed since January 1, 2023.

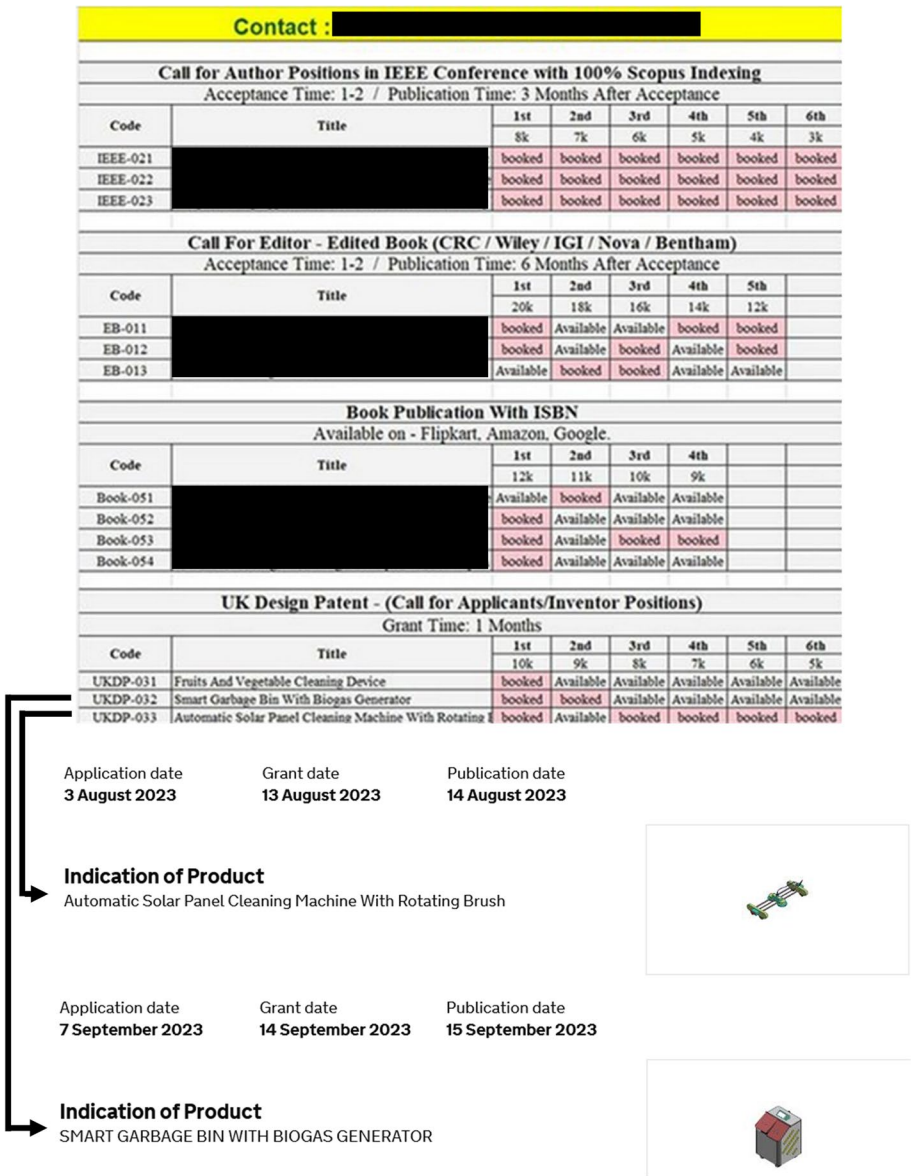
We manually inspected designs on the website of the UK Intellectual Property Office (UK IPO) (Intellectual property: Designs n.d) and company registration on the website of the UK Companies House (Search the register n.d).

Results

Identifying and characterizing UK registered designs with sold authorship

Dozens of Facebook, WhatsApp and Telegram groups serve as advertising spaces for companies involved in education fraud to obtain clients. Services advertised in these groups include but are not limited to authorship slots on pre-written publications to published in peer-reviewed journals or conference proceedings, writing services for research papers and theses and editorship and authorship slots on books and book chapters (Wise 2024, 2024, 2024). In late 2022, advertisements for authorship slots on pre-written "UK design patents" and "India design patents" began appearing in these channels (as noted above, the UK and India do not actually issue design patents, only registered designs). These advertisements will often include information such as the title of the patent (e.g. *"Fully Automatic Tablet Picking Machine"*), the cost of each remaining authorship slot (e.g. *"Applicant 1 +Inventor : Rs. 4000, Applicant 2 +Inventor : Rs. 3500, Applicant 3 +Inventor : BOOKED"*), expected time from filing to acceptance (e.g. *"*Ready to File*, Duration : *14 - 21 days*"*) and language emphasizing the value of these patents for individual and institutional reputations (e.g. *"Patent Filing and publication will be useful for API* [Academic Performance Indicator, the former name of the research scoring system specified by the UGC]*, NBA* [National Board of Accreditation, MOE accreditation board for technical programs], *NAAC* [National Assessment and Accreditation Council, MOE accreditation system for colleges and universities], *NIRF and ARIIA Ranking* [Atal Ranking of Institutions on Innovation Achievements, former MOE ranking system for colleges and universities, predecessor of NIRF]").

One such advertisement, posted in a Facebook group with 3,400 members on July 23, 2023, is shown in Fig. 1. Alongside offers for authorship on Institute of Electrical and Electronics Engineers (IEEE) conference papers, editorship on published books, and authorship on published book, the advertisements lists available authorship positions



Contact : [redacted]

Call for Author Positions in IEEE Conference with 100% Scopus Indexing

Acceptance Time: 1-2 / Publication Time: 3 Months After Acceptance

Code	Title	1st	2nd	3rd	4th	5th	6th
		8k	7k	6k	5k	4k	3k
IEEE-021	[redacted]	booked	booked	booked	booked	booked	booked
IEEE-022		booked	booked	booked	booked	booked	booked
IEEE-023		booked	booked	booked	booked	booked	booked

Call For Editor - Edited Book (CRC / Wiley / IGI / Nova / Bentham)

Acceptance Time: 1-2 / Publication Time: 6 Months After Acceptance

Code	Title	1st	2nd	3rd	4th	5th	
		20k	18k	16k	14k	12k	
EB-011	[redacted]	booked	Available	Available	booked	booked	
EB-012		booked	Available	booked	Available	booked	
EB-013		Available	booked	booked	Available	Available	

Book Publication With ISBN

Available on - Flipkart, Amazon, Google.

Code	Title	1st	2nd	3rd	4th		
		12k	11k	10k	9k		
Book-051	[redacted]	Available	booked	Available	Available		
Book-052		booked	Available	Available	Available		
Book-053		booked	Available	booked	booked		
Book-054		booked	Available	Available	Available		

UK Design Patent - (Call for Applicants/Inventor Positions)

Grant Time: 1 Months

Code	Title	1st	2nd	3rd	4th	5th	6th
		10k	9k	8k	7k	6k	5k
UKDP-031	Fruits And Vegetable Cleaning Device	booked	Available	Available	Available	Available	Available
UKDP-032	Smart Garbage Bin With Biogas Generator	booked	booked	Available	Available	Available	Available
UKDP-033	Automatic Solar Panel Cleaning Machine With Rotating B	booked	Available	booked	booked	booked	booked

Application date **3 August 2023** Grant date **13 August 2023** Publication date **14 August 2023**

Indication of Product

Automatic Solar Panel Cleaning Machine With Rotating Brush

Application date **7 September 2023** Grant date **14 September 2023** Publication date **15 September 2023**

Indication of Product

SMART GARBAGE BIN WITH BIOGAS GENERATOR

Fig. 1 Portion of a July 23, 2023 advertisement posted to a Facebook group with 3,400 members (top). Alongside offers for authorship on IEEE conference papers, editorship on published books, and authorship on published book, the advertisements lists available authorship positions on three UK registered designs. We found registered designs with product indications matching two of these listed titles filed and granted shortly thereafter (designs # 6301322 and # 6308402, bottom). Additional examples of advertisements linked to eventually-granted designs are shown in Figures S1 - S7

on three UK registered designs. Registered designs with product indications matching two of these listed titles, "Smart Garbage Bin with Biogas Generator" and "Automatic Solar Panel Cleaning Machine with Rotating Brush", were filed on September 7, 2023 and August 3, 2023 and granted on September 14, 2023 (7 days) and August 13, 2023 (10 days), respectively.

We have identified 20 similar instances where an advertisement was posted for authorship positions on a UK registered design and an application to register a design with

a matching product indication was filed and granted in the UK shortly thereafter (Figures S1 - S7). Each of these designs were filed on behalf of their owners by two firms (i.e. "representatives"): Firm A and Firm E. Firm A is registered in the UK at its claimed address but does not have any identifiable web presence. Firm E is not registered in the UK at its claimed address but does have a website and claims to be an IP firm based in India. The address listed by Firm E on its design filings is the registration address for more than 5,000 active UK companies (Search the register n.d).

We downloaded every registered design filed in the UK by these two companies (1,343 by Firm A, 614 by Firm E, 1,957 in total). Both companies began filing UK registered designs in early 2023 (Fig. 2a). The median number of owners listed on each design was 6, and these inventors were almost exclusively Indian academics or their employers. For 97 of the 1,957 patents (5.0%), a university was listed as an applicant. The designs filed by these firms tended to follow common themes; for instance, popular keywords in designs' product indications included "device", "smart", "AI" (artificial intelligence) and "cancer" (Fig. 2b). Many registered designs claimed to be "AI-based", "smart" or "IoT [internet of things] enabled". The most common Locarno designations (Locarno classification n.d) included 24.01: Apparatus and equipment for doctors, hospitals and laboratories, 14.02: Data processing equipment as well as peripheral apparatus and devices and 10.05: Instruments, apparatus and devices for checking, security of testing (Fig. 2c). The median time between the date of filing and the date the design registration was granted was 11 days (Fig. 2d). For comparison, it takes on average about 22 months for a US design patent to be granted by the US Patent and Trademark Office or otherwise abandoned (Design Data,October 2024 n.d).

As discussed above, registered designs (like US design patents) protect how a product looks, not how it functions. Thus, the applicant does not have to support (and the UK IPO will not check) any implicit claims about product performance that may be made in the title or indication of the product. This proves advantageous for Firm A and Firm E, as the indications they provide are often cartoonish and implausible in relation to the product they describe (Fig. 2e).

It is also notable that Firm A and Firm E appear to re-use images in multiple applications, often filing registrations using the same exact images but with different titles and different sets of owners. 171 of 614 (27.9%) designs filed by Firm E used the exact same images as another design filed by Firm E and 4 of 1,343 (0.3%) designs filed by Firm A used the exact same images as another design filed by Firm A. The same set of images were re-used on up to five distinct designs. For instance, between August 21, 2023 and March 2, 2024, five different designs were filed using the same images but with different titles (ranging from "AI Based Device to Suggest Product to the Customers" to "Voice Based Email Sending Device") and different sets of owners (Fig. 3).

Crude name disambiguation and manual inspection revealed that the two most common applicants, with 59 and 51 registered designs each, were engineering professors in India that founded and operate a contract cheating firm publicly advertising patent filing as one of their services. A list of services and their stated prices, found in the description of a Feb 26, 2022 Hindi-language YouTube video titled "7 Key Point to Improve Salary", is shown in Table 1. Every service advertised would accrue points in the research score scheme specified by the UGC (UGC regulations on minimum

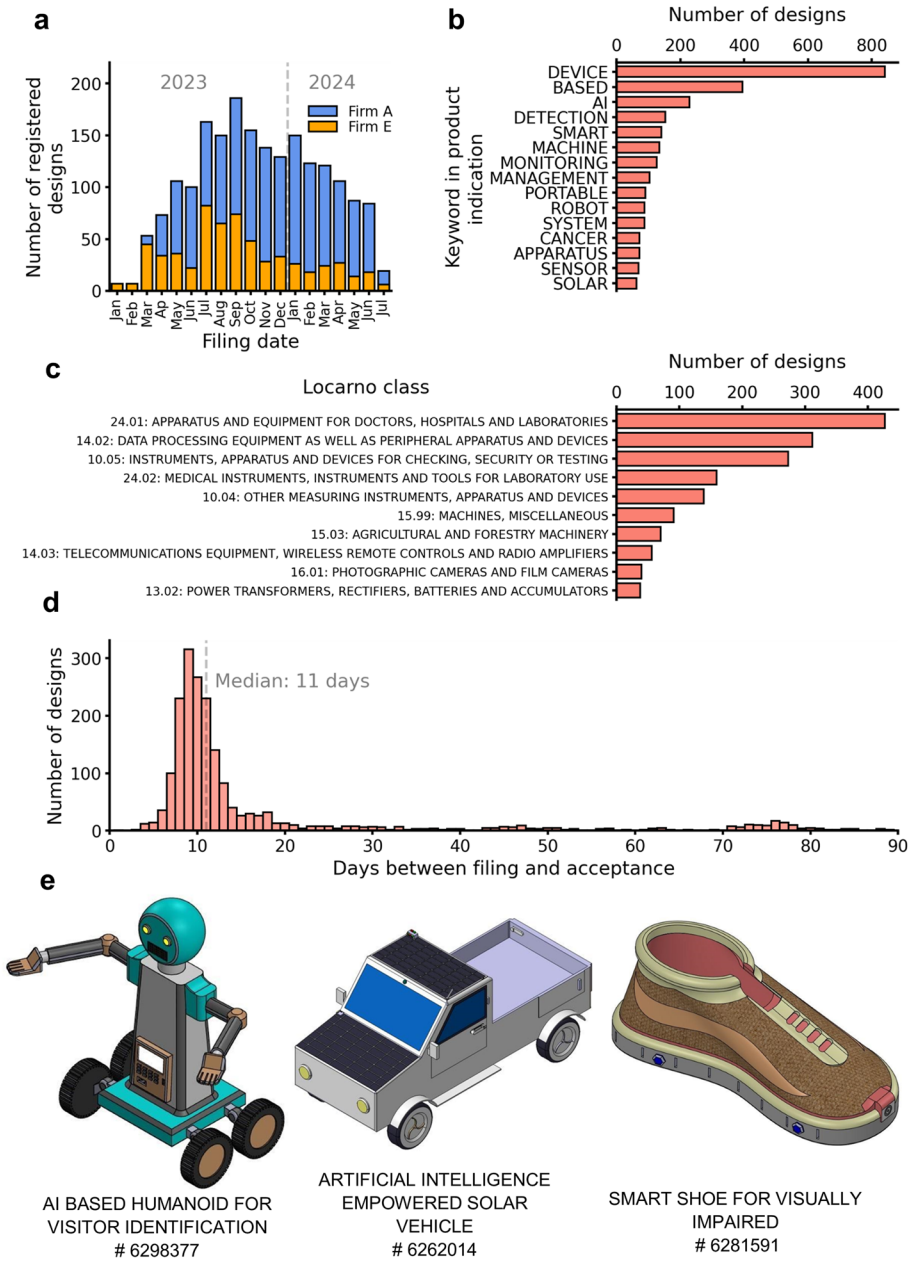


Fig. 2 Characterization of UK design patents filed by two firms linked to sale of patent authorship to academics: Firm A and Firm E. **a** monthly counts of patents filed by Firm A and Firm E. Both firms began filing in early 2023. **b** the most common non-stopwords contained in product indications of patents filed by Firm A and Firm E. **c** the most common Locarno classes (Locarno classification n.d) to patents filed by Firm A and Firm E. **d** distribution of delay times between filing and acceptance of patents filed by Firm A and Firm E. **e** examples of patents filed by Firm A and Firm E. Designs filed by these two firms tended to be cartoonish with implausible product indications

qualification for appointment of teachers and other academic staff in universities and colleges and measures for the maintenance of standards in higher education 2018). Many would accrue points for an institution in NIRF (India rankings 2023 National Institutional Ranking Framework methodology for ranking of academic institutions

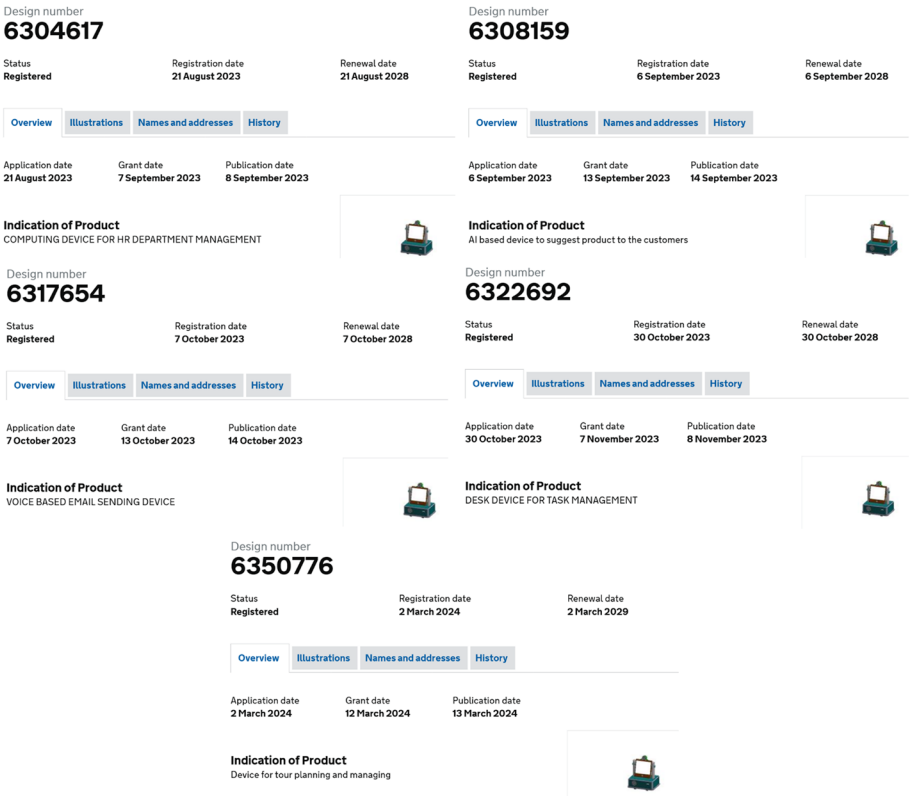


Fig. 3 Over a six-month period, five distinct designs were filed by Firm E that used the exact same images, but with different product indications and on behalf of different sets of owners

in india (ranking metrics for overall) n.d). Additional advertisements posted by this firm on Instagram are shown in (Figures S8 - S17).

Expanding the search for related firms

To expand our search for firms possibly also in the business of filing UK registered designs for academic reputation manipulation, we downloaded all 1,426 registered designs filed under Locarno class 24.01, the most common class for designs filed by Firm A and Firm E, since January 1, 2023. We then identified the 15 firms that had filed the most designs under this class and downloaded every design each firm had filed since January 1, 2023. The number of designs filed in total and under Locarno class 24.01 since January 1, 2023 by each firm is shown in Table 2 and Fig. 4a.

Of these 15 firms, 7 began filing UK designs before January 1, 2023 and are well-established British and European IP firms. The remaining 8 (including Firm A and Firm E) began filing UK designs after January 1, 2023 and have little to no web presence. Those with a web presence appear to be based in India and list no UK offices. Two such firms, Firm A and Firm I, file their designs from the same address. Another firm, Firm M, files their designs from an address advertised elsewhere as a "virtual office" for which one can purchase the right to receive mail for 16 GBP (21 USD) per month.

These two groups of firms (henceforth "legitimate firms" and "suspicious firms") differ drastically in the character of their registered designs. While legitimate firms never list

Table 1 Services advertised in the description of a February 26, 2022 YouTube video posted by the second most prolific client of Firm A and Firm E. Prices are converted from INR to USD using a February 2022 exchange rate of 0.0133 (Inr/usd historical prices n.d). Additional advertisements posted by this firm on Instagram are shown in Figures S8 - S17

Service (as advertised)	Price (INR)	Price (USD)
Utility Patent: India, First Position	7,950	105
Design Patent: India, First Position	7,950	105
UK-Design Patent: United Kingdom, First Position	11,950	158
Germany Innovation Patent, First Position	11,950	158
USA, UK, Japan Singapore Patent, First Position	29,950	398
National Book: [350 Pages]	Not listed	Not listed
International Book: [350 Pages]	Not listed	Not listed
e-Book: [350 Pages]	Not listed	Not listed
UGC-Care -Print Mode	5,000	67
Scopus (Q3, Q4) Article Writing	12,000	160
Scopus (Q1, Q2) Article Writing	25,000	333
SCI [Springer, Hindawi, MDPI, Elsevier, and IEEE Article Writing	85,000	1,131
Funded Project [AICTE, DST, IEI, NHRD, Startup: Documentation:	25,000	333
Consultancy Work: Documentation	25,000	333
International Award	Not listed	Not listed
National Awards	Not listed	Not listed
National Conference Proceeding	12,500	166
International Conference Proceeding	16,500	219
Start-up / LLP, Pvt. Ltd. Company Registration	25,000	333
Website Develop	25,000	333
MoU (National)	5,000	67
MoU (International)	25,000	333
NAAC: Criteria 3: Documentation	Not listed	Not listed
NBA : Criteria 5: Documentation	Not listed	Not listed
NIRF-Ranking, NAAC, NBA: 1: Documentation	Not listed	Not listed
Digital E Learning: 1: Documentation: Available: 2: YouTube: Teaching Videos Views, 3: Sub: Increased	Not listed	Not listed
Co-Guide Registration	Not listed	Not listed
Ph.D Thesis Writing: 200-Page		
under 5% Plagiarism with-Turnitin	40,000	532
Ph.D Thesis Writing: 350-Page		
under 5% Plagiarism with-Turnitin	60,000	798
Industry Sponsored Labs PPD lab, Idea Lab, Reseaech Lab, Incubation Center, Center of Excellence, Business Intelligence, IB Lab, AI Lab, Robotics Lab, Programming Lab	Not listed	Not listed

more than 2 applicants on their designs, suspicious firms tend to list between 4 and 10 applicants, nearly exclusively Indian academics and universities (Fig. 4b). The designs filed by the other suspicious firms tend to follow the same distinctive artistic and textual style used by Firm A and Firm E. For instance, while designs filed by legitimate firms tended to have short, to-the-point product indications (e.g. "Lamp", "Footwear"), designs filed by suspicious firms tended to long, flowery titles that emphasized the novelty and apparent functionality of the product (e.g. "Novel IoT Based Laser Treatment Physiotherapy Device") (Fig. 4c). While designs filed by both types of firm were granted a median of 11 days after filing, designs filed by legitimate firms were more likely to wait

Table 2 UK registered designs filed since January 1, 2023 by the 15 firms that have filed the most designs under Locarno class 24.01 since January 1, 2023

Firm	Type	Number of designs	Under Locarno class 24.01
A	Suspicious	1,343	296
B	Legitimate	761	48
C	Legitimate	725	45
D	Legitimate	622	41
E	Suspicious	614	131
F	Legitimate	516	21
G	Legitimate	301	30
H	Suspicious	292	35
I	Suspicious	277	114
J	Legitimate	181	21
K	Suspicious	181	63
L	Suspicious	166	46
M	Suspicious	123	28
N	Legitimate	102	20
O	Suspicious	69	21

an extended period for granting (two-sided Mann Whitney U test $p = 0.003$, Fig. 4d). Legitimate firms were 7.3 times as likely to wait 100 days or longer between filing and acceptance than suspicious firms. The reasons for this are unclear.

Suspicious firms were also far more likely to file designs sharing the exact same product indication (disregarding changes in capitalization and punctuation) than legitimate firms (Fig. 4e). For instance, 6 different designs with the product indication "Device for Detecting Diseased Leaves in Plant by Image Processing" were filed by 4 different suspicious firms between August 17, 2023 and December 31, 2023. While legitimate firms also filed some designs with identical product indications, these occurred less frequently and for products with far less descriptive product indications (e.g. "Cup" and "Packaging"). There were only 2 instances where a suspicious firm filed a design with the same product indication as a legitimate firm ("Safety Helmet" and "Helmet").

Just the 8 suspicious firms we describe here have registered 3,065 designs since January 1, 2023, about 3.3% of all designs registered in the UK in that period.

Designs that copy another work

One suspicious firm, Firm H, repeatedly filed designs that appear to have been copied from publicly-available 3D models. For instance, the design "Designing an Artificial Intelligence Powered Skin Cancer Inspection Device with Design Thinking", filed on November 2, 2023, is clearly a 3D model of a Glock pistol with a screen and USB ports attached (Fig. 5a). In fact, Glock Gmbh registered designs for similar pistols in 2014. We identified 4 other instances where the designs registered by Firm H have apparently repurposed existing 3D models from publicly available repositories with minimal changes (Fig. 5b, c, Figure S18).

Curiously, there is an existing engineering consulting firm with the same name as Firm H that is registered in the same UK business park, but at a different address

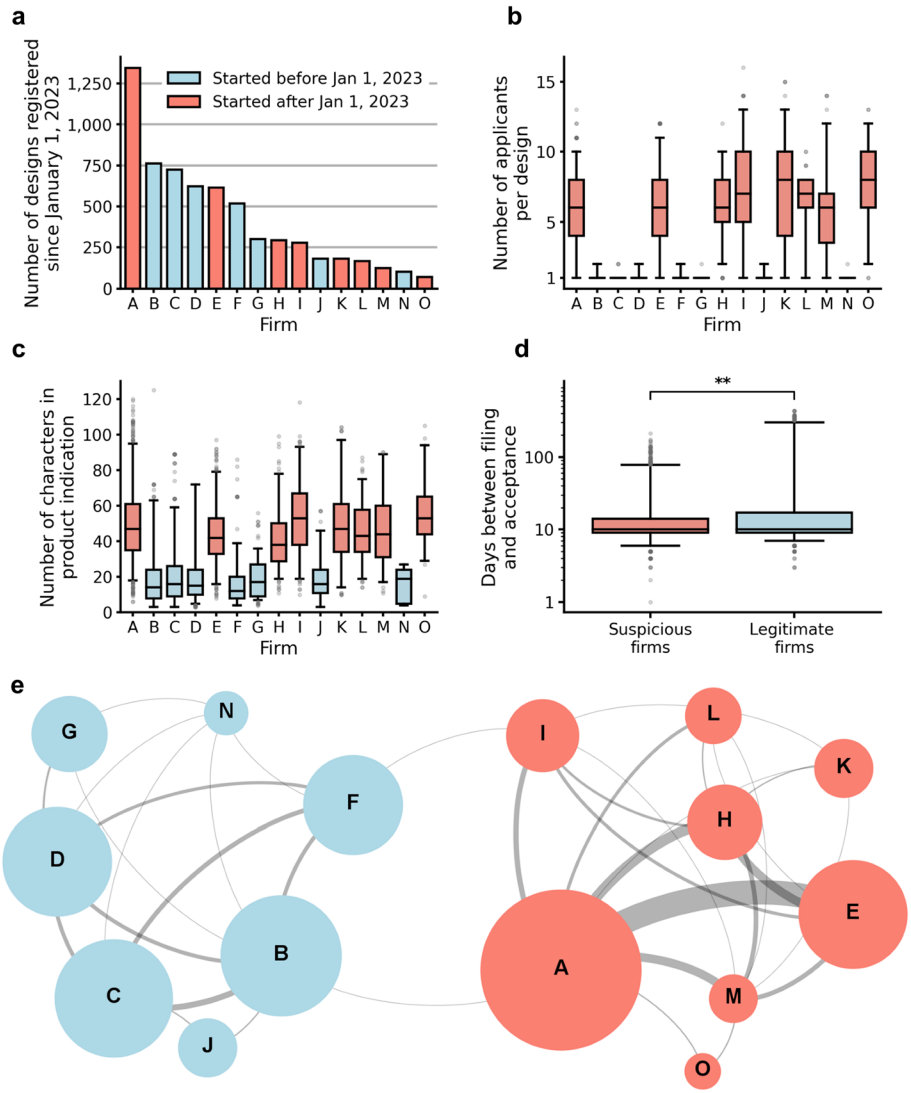


Fig. 4 Characterization of UK registered designs filed since January 1, 2023 by 15 firms. **a** Firms could be classified into two groups: those that started filing UK designs before January 1, 2023 ("legitimate", light blue) and those that started after January 1, 2023 ("suspicious", salmon). **b** designs filed by legitimate firms never listed more than two parties as applicants, whereas designs filed by suspicious firms tended to list between 4 and 10. **c** product indications of designs filed by suspicious firms tended to be much longer than those filed by legitimate firms. **d** although the median grant time for both suspicious and legitimate firms was 11 days, legitimate firms were far more likely to wait an extended period between filing and acceptance. ** indicates $p < 0.01$ by two-sided Mann-Whitney U test. **e** network in which nodes are scaled by the number of designs filed by each firm (between 69 and 1,343) and edges are scaled by the number of designs filed by each firm that share the exact same product indication as those filed by another firm (between 1 and 37). Suspicious firms tended to file designs with the same, long product indication far more often than legitimate firms with their relatively short product indications

from that which was used to file these designs. This suggests that at least some of these firms have assumed the identities of other legitimate businesses to conduct their work, similar to instances of impersonation employed by paper mills to lend credibility to their products or gain access to publishing routes (Else 2021; Kaiser 2013; Downes 2021).

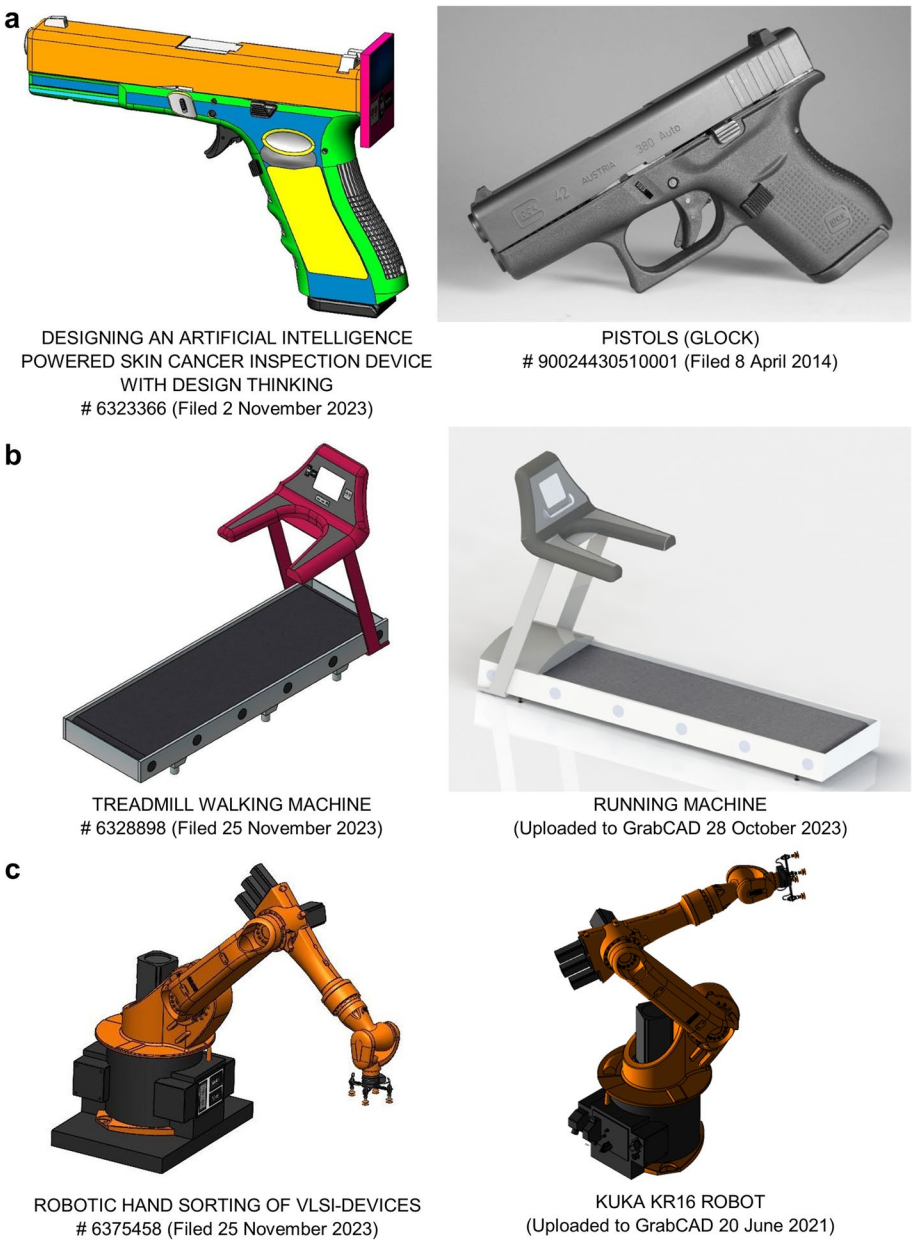


Fig. 5 Examples of designs that apparently copy another work filed by one suspicious firm, Firm H. **a** the registered design on the left, claiming to represent an AI-powered skin cancer inspection device, is clearly a colorful Glock pistol with a screen and USB ports attached. For reference, a design previously registered in the UK by Glock Gmbh is shown on the right. **b** the registered design on the left is a near-exact reproduction of the 3D model shown on the right, posted a month earlier on public 3D model repository site GrabCAD (Grabcad community n.d). **c** the registered design on the left is a near-exact reproduction of the 3D model shown on the right, posted years earlier on GrabCAD. This design also closely resembles an existing product, the Kuka KR16 robot. Additional examples are shown in Figure S18

Discussion

Here, we describe the exploitation of an IP system for the purpose of academic reputation manipulation, specifically the use of the UK system of registered designs to augment the reputations of Indian academics. These services are offered alongside

other services more readily associated with education fraud (e.g. thesis writing (Draper et al. 2017; Draper and Reid-Hutchings 2019; Medway et al. 2018)) and publication fraud (e.g. authorship-for-sale (Abalkina and Bishop 2023; Abalkina 2023)). Just as publication fraud services are sought due to career incentives to publish scholarly works (Hvistendahl 2013; Stone 2016; Han and Li 2018; Memon and Rathore 2021; Byrne et al. 2022; Else 2023; Joelving 2024), the services we describe here are sought due to career incentives to secure IP rights. Similar schemes could realistically find customers in any context (academic or even industrial) where patents and other IP are in demand, especially where they factor into performance evaluation criteria.

Within the UK design registration system, we find that filings made by legitimate firms are markedly different from those made by suspicious firms. This invites the use of signature-based risk detection in IP systems, similar to analyses routinely employed in cybersecurity (Liao et al. 2013) and recently employed for identifying publication fraud (Cabanac et al. 2022; Porter and McIntosh 2024).

Targeting of UK registered designs

UK registered designs seem to represent a particularly attractive business model for those selling reputation manipulation to Indian academics for several reasons. First, registered designs do not require ex ante novelty examination (unlike design patents) but can apparently be passed off as patents. Second, like design patents, registered designs do not require the applicant to prove that their product is functional. However, by giving their designs technical-sounding titles, these designs retain the appearance of representing an innovative invention. Third, patents granted outside of India are more valuable than Indian patents according to the points-based scheme specified by the UGC and have equal or greater value than peer-review publications (UGC regulations on minimum qualification for appointment of teachers and other academic staff in universities and colleges and measures for the maintenance of standards in higher education 2018). Fourth, filing UK registered designs requires a very low fee payment of at most 50 GBP / 64 USD per design registered (Register a design n.d), well below the expected revenue from multiple academics purchasing an authorship slot on the same design (Table 1). Fifth, UK registered designs are granted very quickly (Fig. 4d), guaranteeing the same value for the client but in a fraction of the time as a peer-reviewed article. The contents of these design applications suggest a high-throughput business model aimed at cutting out unnecessary steps in production, similar to that employed by research paper mills (Byrne et al. 2022, 2024).

Harms of intellectual property exploitation for reputation manipulation

The phenomenon we describe engenders several potential harms. First, academics buying design ownership (in a manner that suggests inventorship) through contract cheating firms expose themselves to the threat of extortion and blackmail, similar to those that buy fake diplomas (Ezell 2023) and essay-writing services (Draper et al. 2021; Yorke et al. 2022). Second, these services further perpetuate academic inequality by providing career advantages to those able to pay to manipulate their reputations. Third, the volume of spurious filings made through this enterprise has the potential to slow the processing of legitimate patents and design registrations. Finally, even if this enterprise produces only frivolous and low-quality IP rights, these rights may still provide significant real-world

value to their owners. Even if no infringement has actually occurred, holding registered design rights afford the owner the ability to tie up competitors in litigation, squeeze out licensing fees under the threat of litigation and diminish the rate of genuine innovations (Allison et al. 2017; Masur 2010; Burstein 2016).

Potential interventions

Interventions against the exploitation of intellectual property systems for academic reputation manipulation should focus on removing incentives that compel academics to seek these services. These interventions might be modeled on those that are currently being employed to counteract unethical behavior in academic publishing. For instance, in February 2020 the Ministry of Education and the Ministry of Science and Technology of China issued a joint opinion discouraging institutions from offering cash rewards to researchers in exchange for publishing scientific articles (Some opinions on the appropriate use of sci-related indicators and re-orientation of research assessment 2020; Qian et al. 2020). Previously, this practice was widespread (Quan et al. 2017) and was thought to motivate academics and physicians in China to seek the services of paper mills (Mallapaty 2020; Byrne and Christopher 2020). The opinion also recommends against the direct use of quantitative heuristics for rankings and research assessment. It is still unclear how effective these interventions have been for reducing unethical publishing behavior and demand for paper mill products in China. The government of India might follow this model by withdrawing the UGC points-based promotion scheme and reducing the role of IP and publication metrics in NIRF.

It might also be effective to design interventions to increase the cost of business for firms offering academic reputation manipulation. For instance, the UGC could immediately clarify that registered designs and other forms of IP rights that are issued without ex ante novelty examination should not count as patents under their promotion guidelines. This would restrict contract cheating firms to filing actual patents, which do not issue as quickly as design registrations and require significantly more effort to prepare and have accepted. However, this intervention alone would only force firms to adapt and do nothing to decrease demand for these firms' services.

Limitations

Our findings have several limitations. First, although we have found advertisements suggesting that similar practices are occurring for utility patents, design patents, utility models, design registrations and copyright registrations in the US, Germany, Japan, India, Singapore, Australia and Canada (Table 1 and Figures S8 - S17, with additional advertisements shown in Figures S19 - S23), we limit our analysis to UK design registrations. Second, all registered design data was obtained from DesignView (DesignView n.d) using the service's "Export to Excel" function. This limited downloads to 150 at a time, limiting the number of designs we could download in total. Having access to the totality of designs recently filed and registered in the UK would allow for a more comprehensive assessment of the extent of the issue. February 2023 requests to DesignView and the UK IPO for higher-volume access to this data went unanswered. Third, several components of registered designs were absent from exported DesignView search results. These included applicant addresses, representative addresses, and additional illustrations associated with the design. Because we only had access to thumbnail images (i.e. the first illustration associated with the design),

we may underestimate the extent of image re-use across multiple designs. Fourth, we can only access UK designs that have been granted. Thus, it is unclear how often UK registered design applications are rejected by the UK IPO or withdrawn by their applicants.

Conclusions

Selling ownership of IP to others for gain and exploitation is entirely legitimate and standard commercial practice. Misrepresenting inventorship is not. We seek to demonstrate a concerning development where IP rights are being acquired in relation to spurious designs and inventions for the purpose to accruing an unfair advantage against academic peers. The fact that established education fraud businesses have gone to the trouble and expense of obtaining IP rights demonstrates that, in their view, there is a market there to be developed and exploited.

It is therefore incumbent upon educational institutions that place a value upon IP rights as part of their promotion or recruitment criteria to investigate and exercise due diligence in relation to IP claims made by applicants and employees. One of the reasons why the registered designs we describe are titled so descriptively is likely to misrepresent the type of innovation protected and its value to the institution. The emergence of these practices also raises the question of whether possession of IP rights should be considered in individual and institutional evaluation schemes in the first place.

Our findings suggest an extraordinary diversity of services offered under the same roof by firms specializing in contract cheating. Terms like "diploma mill" (Ezell 2023), "essay mill" (Draper et al. 2017), "paper mill" (Byrne et al. 2022; Paper mills — research report from COPE and STM 2022; Byrne et al. 2024; Parker et al. 2024), "contract cheating" (Eaton and Carmichael 2023), "admissions fraud" (DeCoster 2023) and others imply that these services and the businesses that offer them are distinct. We argue that these services should be interpreted as different facets of the same global enterprise of education fraud, both because such services are likely to be offered in tandem by the same firms and because all serve one of three purposes: simplifying career milestones, manipulating individual reputations or manipulating institutional reputations.

That being said, this practice does differ from the sale of essays, articles, diplomas, qualifications and other embellishments in that IP rights are genuinely granted and protected. This opens new, unanticipated frontiers in the fight against education fraud. Scholars in education fraud and institutions should, therefore, be aware of these new developments and attempt to anticipate how other systems might be exploited for academic reputation manipulation in the future.

Abbreviations

UK	United Kingdom
IP	Intellectual Property
UGC	University Grants Commission
MOE	Ministry of Education
NIRF	National Institutional Ranking Framework
API	Academic Performance Indicators
NBA	National Board of Accreditation
NAAC	National Assessment and Accreditation Council
ARIIA	Atal Ranking of Institutions on Innovation Achievements
IEEE	Institute of Electrical and Electronics Engineers
US	United States
UK IPO	UK Intellectual Property Office
AI	Artificial intelligence
IoT	Internet of Things

Supplementary Information

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Supplementary Material 1.

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Authors' contributions
Conceptualization: RAKR, NHW Methodology: RAKR, SSH Software: RAKR, SSH Validation: RAKR Formal analysis: RAKR Investigation: RAKR, NHW, SSH Resources: RAKR Data curation: RAKR Writing - Original Draft: RAKR, MJD, SF Writing - Review & Editing: RAKR, NHW, SSH, MJD, SF. All authors reviewed the manuscript. Visualization: RAKR Supervision: RAKR Project administration: RAKR Funding acquisition: RAKR.

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Data availability
All registered design data presented in this work is publicly available from DesignView or the UK IPO. Redacted screenshots are available in Supplementary Materials. De-anonymized data has been shared with reviewers and will be shared with relevant parties on request. Code is available at https://github.com/reeserich/ip_exploitation.

Declarations

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The authors declare no competing interests.

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